PRACTICAL ELECTRONICS

JANUARY 1970

THR HILLINGS

Toorak Village Newsagency 0.40

ıstralia	40c
ew Zealand	35c
outh Africa	30c
ıodesia	3/-
ıst Africa	3/00
est Africa	3/- (30c)

THYRISTORS and the EXPERIMENTER

POWER CONTROL IN A.C. AND D.C. CIRCUITS

ADCOLA
PRODUCTS LIMITED
(Regd Trade Mark)

THE RELIABLE SOLDERING INSTRUMENT!

SEND COUPON FOR LATEST LEAFLET

ADCOLA PRODUCTS LTD
ADCOLA HOUSE
GAUDEN ROAD
LONDON SW4
01-622 0291/3

NAME.....

ADDRESS.....

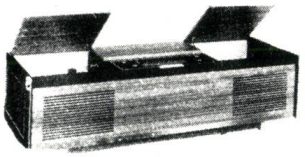
.....

.....

.....

PE170

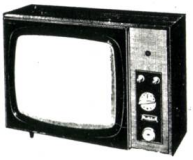
STEREOGRAM CABINET £19
An elegant Stereogram Cabinet in modern Veneered Mahogany and cloth covered Front Panel
BLACK LEATHERETTE SIDE PANELS
Dimensions: 52" × 17½" × 12". Speaker positions for Twin 10" × 5" Speakers



SPEAKERS 6/6
2"—75Ω. 2½"—35Ω. P. & P. 2/6.
ACOS MICS. 35/- STANDARD
STICK MIC. 2gns. P. & P. 3/6.
ASSORTED CONDENSERS
10/- for 50. P. & P. 7/6.
ASSORTED RESISTORS
10/- for 50. P. & P. 4/6.
ASSORTED CONTROLS
10/- for 25. P. & P. 7/6.
TRANSISTORS
MULLARD MATCHED OUTPUT KIT
9/- OC81D—2 OC81's.
P. & P. FREE.
FERRITE RODS 3/6
6", 8" × ⅜" complete with LW/MW COILS. P. & P. FREE.

17in.—£11.10.0 Carr. 30/-
19in. SLIM-LINE FERGUSON 24 gns.
TWO-YEAR GUARANTEE EX-RENTAL TELEVISIONS

FREE ILLUSTRATED LIST OF TELEVISIONS 17"—19"—21"—23"



WIDE RANGE OF MODELS SIZES AND PRICES
DEMONSTRATIONS DAILY

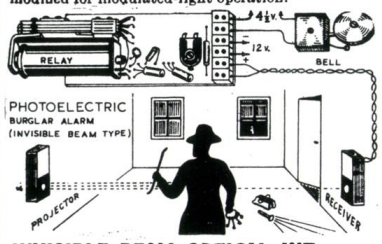
RECORD PLAYER CABINET 49/6.
Cloth covered. Size 16¾" × 14½" × 8" Takes any modern autochanger. P. & P. 7/6.
SINGLE PLAYER CABINETS 15/6. P. & P. 7/6.
TRANSISTOR CASES 19/6.
Cloth covered, many colours. Size 9½" × 6½" × 3½". P. & P. 3/6.
Similar cases in plastic 7/6.

TWO-YEAR GUARANTEED REGUNNED TUBES
70° & 90° 14in.—**69/6**, 17in.—**89/6**, 21in.—**99/6**. 110° 17in., 19in. & 21in.—**99/6**. 23° (not bonded)—**119/6**. Exchanged Bowls. Carr. 10/6.

DUKE & CO. (LONDON) LTD.
621/3 Romford Road, Manor Park, E.12
Phone 01-478 6001-2-3 Stamp for Free List.

PHOTOELECTRIC KIT

CONTENTS: 2 P.C. Chassis Boards, Chemicals, Etching Manual, Infra-Red Photo-transistor, Latching Relay, 2 Transistors, Condensers, Resistors, Gain Control, Terminal Block, Elegant Case, Screws, etc. In fact everything you need to build a Steady-Light Photo-Switch/Counter/Burglar Alarm, etc. (Project No. 1) which can be modified for modulated-light operation.



PHOTOELECTRIC KIT
39/6
Postage and Pack. 2/6 (UK)
Commonwealth:
SURFACE MAIL 3/6
AIR MAIL £1.0.0
Australia, New Zealand S. Africa, Canada and U.S.A.
Also Essential Data Circuits and Plans for Building 10 Advanced Designs

INVISIBLE BEAM OPTICAL KIT
Everything needed (except plywood) for building: 1 Invisible-Beam Projector and 1 Photocell Receiver (as illustrated). Suitable for all Photoelectric Burglar Alarms, Counters, Door Openers, etc.
CONTENTS: 2 lenses, 2 mirrors, 2 45-degree wooden blocks, Infra-red filter, projector lamp holder, building plans, performance data, etc. Price **19/6**. Postage and Pack. 1/6 (U.K.). Commonwealth: Surface Mail 2/-; Air Mail 8/-.

LONG RANGE INVISIBLE BEAM OPTICAL KIT
CONTENTS: As above. Twice the range of standard kit. Larger Lenses, Filter, etc. Price **29/6**. Postage and Pack. 1/6 (U.K.). Commonwealth: Surface Mail 2/6. Air Mail 10/-.

JUNIOR PHOTOELECTRIC KIT
Versatile Invisible-beam, Relay-less, Steady-light Photo-Switch, Burglar Alarm, Door Opener, Counter, etc., for the Experimenter.
CONTENTS: Infra-Red Sensitive Phototransistor, 3 Transistors, Chassis, Plastic Case, Resistors, Screws, etc. Full Size Plans, Instructions, Data Sheet "10 Advanced Photoelectric Designs".
Price **19/6**. Postage and Pack. 1/6 (U.K.). Commonwealth 2/-; Air Mail 4/-.

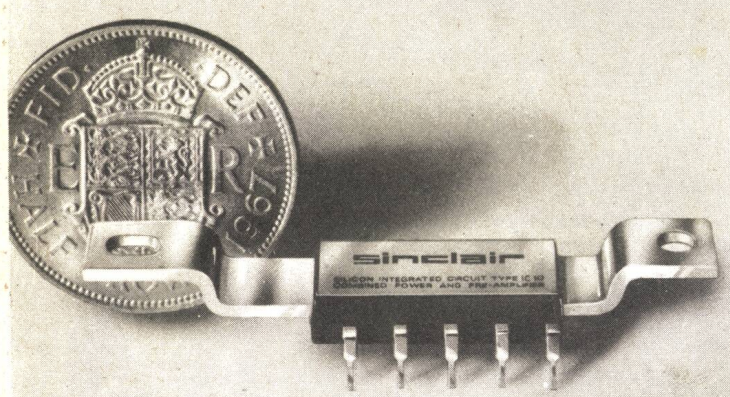
JUNIOR OPTICAL KIT
CONTENTS: 2 Lenses, Infra-red Filter, Lampholder, Bracket, Plans, etc. Everything (except plywood) to build 1 miniature invisible beam projector and photocell receiver for use with Junior Photoelectric Kit.
Price **10/6**. Post and Pack. 1/6 (U.K.). Commonwealth: Surface Mail 2/-; Air Mail 4/-

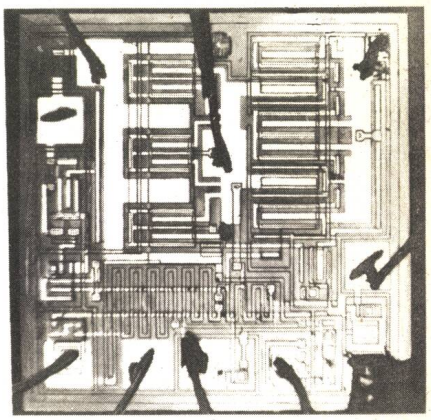
YORK ELECTRICS
333 YORK ROAD, LONDON, S.W.11

Send a S.A.E. for full details, a brief description and Photographs of all Kits and all 30 Radio, Electronic and Photoelectric Projects Assembled.

SINCLAIR IC-10

10 WATT MONOLITHIC INTEGRATED CIRCUIT AMPLIFIER AND PRE-AMP





the world's most advanced high fidelity amplifier

The Sinclair IC-10 is the world's first monolithic integrated circuit high fidelity power amplifier and pre-amplifier. The circuit itself, a chip of silicon only a twentieth of an inch square by a hundredth of an inch thick, has an output 5 watts R.M.S. (10 watts peak). It contains 13 transistors (including two power types), 2 diodes, 1 zenor diode and 18 resistors, formed simultaneously in the silicon by a series of diffusions. The chip is encapsulated in a solid plastic package which holds the metal heat sink and connecting pins. This exciting device is not only more rugged and reliable than any previous amplifier, it also has considerable performance advantages. The most important are complete freedom from thermal runaway due to the close thermal coupling between the output transistors and the bias diodes and very low level of distortion.

The IC-10 is primarily intended as a full performance high fidelity power and pre-amplifier, for which application it only requires the addition of such components as tone and volume controls and a battery or mains power supply. However, it is so designed that it may be used simply in many other applications including car radios, electronic organs, servo amplifiers (it is d.c. coupled throughout) etc. The photographic masks required for producing monolithic I.Cs are expensive but once made, the circuits can be produced with complete uniformity and at very low cost. It also enables us to cover every IC-10 with the Sinclair guarantee of reliability.

■ SPECIFICATIONS

Output	10 Watts peak, 5 Watts R.M.S. continuous.
Frequency response	5 Hz to 100 KHz±1dB.
Total harmonic distortion	Less than 1% at full output.
Load impedance	3 to 15 ohms.
Power gain	110dB (100,000,000,000 times) total.
Supply voltage	8 to 18 volts.
Size	1 × 0.4 × 0.2 inches.
Sensitivity	5mV.
Input impedance	Adjustable externally up to 2.5 M ohms.

■ CIRCUIT DESCRIPTION

The first three transistors are used in the pre-amp and the remaining 10 in the power amplifier. Class AB output is used with closely controlled quiescent current which is independent of temperature. Generous negative feedback is used round both sections and the amplifier is completely free from crossover distortion at all supply voltages, making battery operation eminently satisfactory.

■ APPLICATIONS

Each IC-10 is sold with a very comprehensive manual giving circuit and wiring diagrams for a large number of applications in addition to high fidelity. These include stabilised power supplies, oscillators, etc. The pre-amp section can be used as an R.F. or I.F. amplifier without any additional transistors.

SINCLAIR IC.10 *with IC.10 manual and 5 year guarantee* **59/6**

POST FREE

sinclair

SINCLAIR RADIONICS LIMITED
22 NEWMARKET ROAD · CAMBRIDGE
Tel. 0223-52731

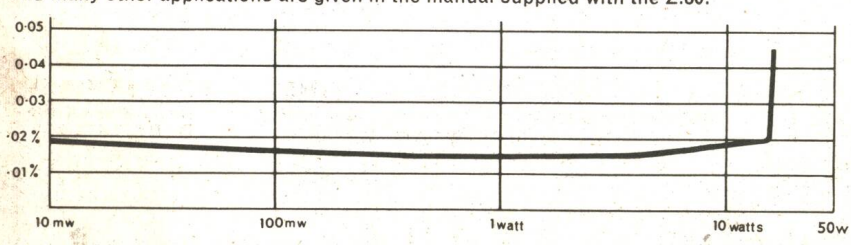
Z.30

THE WORLD'S LOWEST DISTORTION HIGH FIDELITY AMPLIFIER.

For four years, the Sinclair Z.12 dominated the constructor world, being the best selling unit of its kind this side of the Atlantic. Excellent as it was, the new Sinclair Z.30 is still better. Half the size of the Z.12, it has more than twice the power, very much greater gain and a level of distortion 50 times lower. This incredible figure results from using over 60dB of negative feed back with a constant current load to the driver stage obtained by incorporating a two transistor circuit in place of the more usual boot-strapping. 9 silicon epitaxial planar transistors are used to provide enormous power; up to 20 watts RMS sine wave (40 watts peak). The circuitry of this marvellous amplifier allows it to be operated from any voltage from 8 to 35 to perfection. At all output levels, distortion is only 0.02%. This puts true laboratory standards into the hands of every user of a Z.30. Two Z.30s and a new Stereo Sixty will make a stereo assembly of such perfection that it could not be bettered in its class no matter how much you spent. But the Z.30 has an enormous variety of applications, particularly where quality, precision and reliability are essential. It can also be used entirely on its own as an amplifier for an efficient economy record player.

APPLICATIONS

Hi-fi amplifier; car radio amplifier; record player amplifier fed directly from pick-up; intercom; electronic music and instruments; P.A.; laboratory work, etc. Full details for these and many other applications are given in the manual supplied with the Z.30.



SPECIFICATIONS

Power output—15 watts R.M.S. into 8 ohms using a 35V supply: 20 watts R.M.S. into 3 ohms using a 30V supply.

Output—Class AB.
Frequency response—30 to 300,000 Hz ± 1dB.

Distortion—0·02% total harmonic distortion at full output into 8 ohms and at all lower output levels.

Signal-to-noise ratio—better than 70dB unweighted.

Input sensitivity—250mV into 100kΩ.

Damping factor—>500.

Loudspeaker impedances—3 to 15 ohms.

Power requirements—From 8 to 35V d.c. (The Z.30 will operate ideally from batteries if required.)

Size—3½×2½×½ inches.

Built, tested and guaranteed, with circuits and instructions manual

89/6

sinclair

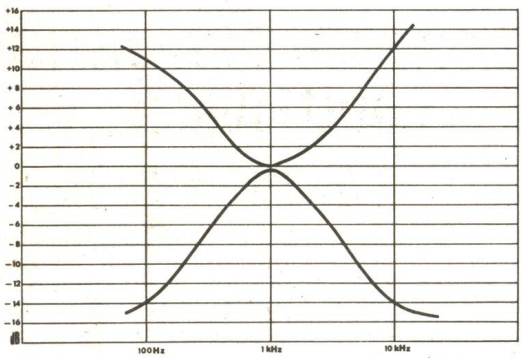
SINCLAIR RADIONICS LIMITED
22 NEWMARKET RD., CAMBRIDGE Tel: 0223 52731

STEREO SIXTY

PRE-AMP & TONE CONTROL UNIT

This attractive and completely new unit is intended for use with two new Z.30 amplifiers to provide the finest possible standards of stereo reproduction. Four press buttons and four rotary controls are used to provide on-off, three input selectors and Volume, Bass cut/boost, Treble cut/boost and Stereo balance. The on-off button also switches the power amplifiers. The front panel in brushed aluminium is flush mounted to the cabinet front, it being necessary only to drill holes to accommodate the controls. Rear adjustable brackets hold the chassis tight to the cabinet. The very latest ganged rotary controls are used to afford compactness and extra long working life free from noise.

The Stereo-60 may also be used with 2 IC-10's or any other high performance amplifiers.



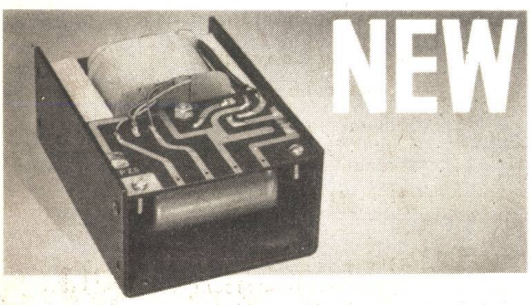
Curves to show bass and treble cut and boost

SPECIFICATIONS

- Input sensitivities—Radio—up to 3mV Magnetic Pickup—3mV: correct to R.I.A.A. curve ± 1dB; 20 to 25,000 Hz. Ceramic Pickup—up to 3mV: Auxiliary—up to 3mV.
- Output—1 volt.
- Signal-to-noise ratio—better than 70dB.
- Channel matching—within 1dB.
- Tone Controls—TREBLE +15 to —15dB at 10 KHz: BASS +15 to —15dB at 100 Hz.
- Power consumption 5mA.
- Front panel—brushed aluminium with black knobs and controls.
- Size 8¼ × 1½ × 4 inches.

Ready built, tested and guaranteed with instructions

£9.19.6



PZ.5 POWER SUPPLY UNIT

A new heavy duty mains power supply unit designed specially to drive two Z.30s and a Stereo Sixty. New compact design.
For AC Mains, 200-240V/50Hz. **£4.19.6**

USE THIS COUPON FOR Z.30, STEREO 60 AND P.Z.5.

Q.16 LOUDSPEAKER AND MICROMATIC ON NEXT PAGE

To: SINCLAIR RADIONICS LTD., 22 NEWMARKET RD., CAMBRIDGE

Please send

.....

.....

.....

.....

For which I enclose cash/cheque money order

NAME .....

ADDRESS .....

.....

.....

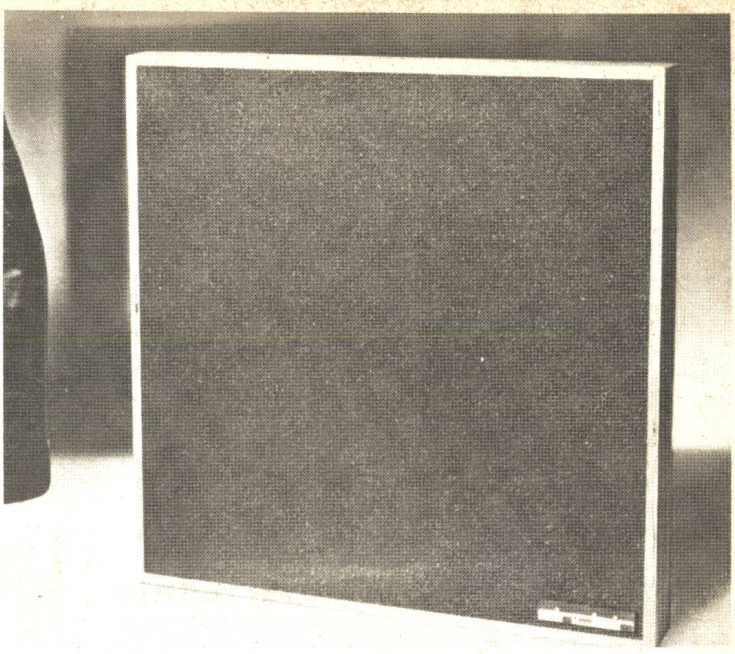
..... PE 170

sinclair

SINCLAIR

Q.16

new elegance in an outstanding loudspeaker



All the superb features which went to make the Sinclair Q.14 have been incorporated in the new Q.16 which gives an exciting new opportunity for you to match your Sinclair equipment with modern decor. Employing the same well proven acoustic system in which materials, processing and styling are used in such a radical and successful departure from conventional design, the new Q.16 presents an entirely new appearance with its attractive teak surround and all-over special cellular foam front chosen as much for its appearance as for its ability to pass all audio frequencies without loss. The Q.16 is compact and slim. Its new styling makes it eminently suitable for shelf mounting, but it is no less versatile than its famous predecessor. Listen to a pair of Q.16s in stereo and marvel at the standards of quality and clarity they give.

The Q.16 will handle loading up to 14 watts R.M.S. and presents an 8 ohm impedance to the amplifier output. Frequency response extends from 60 to 16,000 Hz. with exceptional smoothness. A specially designed driver system is used in a sealed and contoured pressure chamber to ensure good transient response at all frequencies. Size: $9\frac{3}{4}$" square × $4\frac{3}{4}$" deep from front to back.

£8.19.6
POST FREE

SINCLAIR MICROMATIC

The world's most successful miniature radio

Specifications
Size:
$1\frac{13}{16}$" × $1\frac{7}{16}$" × $\frac{1}{2}$" (46 × 33 × 13mm).
Weight incl. batteries:
1 oz. (28·35gm) approx.
Tuning:
Medium wave band with bandspread at higher frequency end.
Earpiece.
Magnetic type.
Case:
Black plastic with anodized aluminium front panel, spun aluminium dial.

Complete kit incl. earpiece, case, solder and instructions in fitted pack. **49/6**
Plus 11d. P.T. surcharge

Ready built, tested and guaranteed, with earpiece. **59/6**
Plus 1/1d. P.T. surcharge

Mallory Mercury Cell RM675 (2 required) each 2/9d.

Considerably smaller than an ordinary box of matches, this is a multi-stage A.M. receiver meticulously designed to provide remarkable standards of selectivity, power and quality. Powerful A.G.C. is incorporated to counteract fading from distant stations; bandspread at higher frequencies makes reception of Radio 1 easy at all times. Vernier type tuning plus the directional properties of the self-contained special ferrite rod aerial makes station separation much easier than with many larger sets. The plug-in magnetic earpiece which matches exactly with the output provides wonderful standards of reproduction. Everything including the batteries is contained within the attractively designed case. Whether you build your Micromatic or buy it ready built and tested, you will find it as easy to take with you as your wristwatch, and dependable under the severest listening conditions.

SINCLAIR GENERAL GUARANTEE

Should you not be completely satisfied with your purchase when you receive it from us, return the goods without delay and your money will be refunded in full, including cost of return postage, at once and without question. Full service facilities are available to all Sinclair customers.

USE THIS COUPON FOR MICROMATIC AND Q.16 ORDERS

To : SINCLAIR RADIONICS LIMITED, 22 NEWMARKET ROAD, CAMBRIDGE

Please send

.....

.....

.....

For which I enclose cash/cheque/money order.

NAME .....

ADDRESS .....

.....

.....

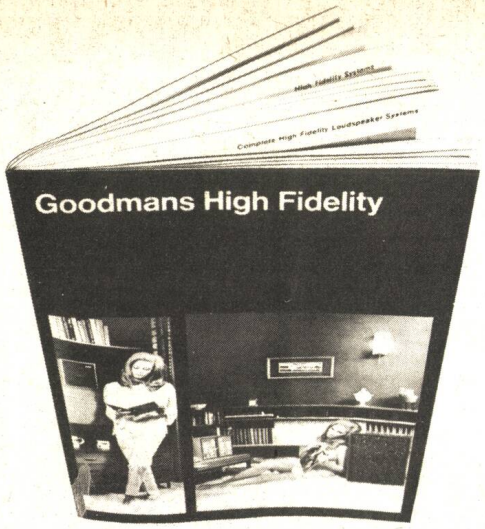
PE 170

sinclair

SINCLAIR RADIONICS LIMITED

22 NEWMARKET ROAD

CAMBRIDGE Tel. 0223 52731



Get a Goodmans Manual today

From cover to cover . . . packed with fascinating articles on Stereo; a beginners guide to High Fidelity: Stage-built Systems: complete details of Goodmans High Fidelity Audio products. 28 pages you can't afford to miss . . . and it's yours FREE!

Please send me a free copy

Name_____

Address _____

PEI/70

Goodmans Loudspeakers Limited
Axiom Works, Wembley, Middlesex. Tel: 01-902 1200

SEND NOW for your

FREE

CALENDAR
DIARY SECTION
DECIMAL COIN TABLE
DATA SHEETS

These are all included in our

1970 ENLARGED CATALOGUE

RESERVE your copy now for despatch early in January

Write to:

W.E.C. LTD. (E)
74 THE STREET, ASHTEAD, SURREY

A new catalogue will be sent to Readers in possession of our 1969 catalogue.

The most accurate pocket size

CALCULATOR

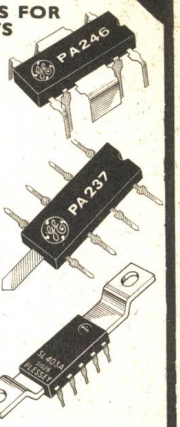
in the world

The 66 inch OTIS KING scales give you *extra* accuracy. Write today for free booklet, or send 82/6 for this invaluable spiral slide rule on approval with money back guarantee if not satisfied.

CARBIC LTD. (Dept. PE26)
54 Dundonald Road, London, S.W.19

Kinver for Components

LINEAR INTEGRATED CIRCUITS FOR ALL YOUR REQUIREMENTS



Plessey SL403A 3W Audio Amplifier	49/6
G.E. Type PA230 Low Level Amplifier	21/–
G.E. Type PA234 1W Audio Amplifier	23/–
G.E. Type PA237 2W Audio Amplifier	34/–
G.E. Type PA246 5W Audio Amplifier	57/–
RCA Type CA3000 d.c. Amplifier	54/9
RCA Type CA3011 Wide Band Amplifier	20/–
RCA Type CA3020 ½W Wide Band Amplifier	32/–
RCA Type CA3028A Differential/Cascode Amp (120MHz)	20/–
RCA Type CA3029 Operational Amplifier	55/2
RCA Type CA3035 Ultra High Gain Amplifier	30/–
Mullard Type TAA263 A.F. Amplifier	15/9
Mullard Type TAA293 General Purpose Amplifier	21/8
Mullard Type TAA310 Record/Playback Pre-Amplifier	32/–
Mullard Type TAA320 MOS L.F. Amplifier	13/5
G.E. Type 2N5306 Darlington Pair	11/6
G.E. Type D13T1 Programmable Unijunction Transistor	10/8

Add 1/– each to the above i.c.s. for data sheets if required. Data sheets may be purchased separately at 1/6 each post free. Issued free with SL403A only.

TRANSISTORS

ACY17	8/8	BC212L	3/9	OC26	9/–	2N1308	9/6
ACY18	4/5	BC213L	3/9	OC28	9/–	2N1309	9/6
ACY19	5/3	BC214L	4/–	OC35	9/–	2N2906	13/–
ACY20	4/6	BCY70	5/4	OC36	9/–	2N2924	4/4
ACY21	4/11	BCY71	10/4	OC71	3/–	2N2925	5/3
ACY22	2/10	BCY72	4/6	OC72	3/9	2N2926	3/–
ACY39	18/–	BD121	18/–	OC75	3/9	2N3053	6/8
ACY40	3/5	BF184	7/6	OC81D	3/–	2N3055	19/6
ACY41	4/4	BF194	7/–	OC170	3/9	2N3702	3/6
ACY44	8/–	BFY50	5/–	OC171	3/9	2N3703	3/3
ASY26	6/2	BFY51	4/6	2N696	4/9	2N3704	3/9
ASY27	8/–	BFY52	5/–	2N697	5/–	2N3705	3/4
ASY28	6/2	BSY95A	3/11	2N706	3/3	2N3707	4/–
ASY29	8/–	MJ481	27/3	2N1132	10/9	2N3708	2/5
BC107	3/3	MJ491	32/11	2N1302	3/11	2N3819	9/–
BC108	3/–	TIP31A	17/–	2N1303	3/11	2N3820	18/9
BC109	3/3	TIP32A	23/–	2N1304	5/–	2N3826	5/11
BC182L	3/2	TIS44	1/9	2N1305	5/–	2N4058	4/6
BC183L	2/5	TIS49	2/6	2N1306	6/5	2N4059	3/5
BC184L	3/2	TIS50	3/9	2N1307	6/5	40408	14/11

2N2160 Unijunction 14/11

DIODES

AA119	3/–	OA91	1/3	1N82A	9/6	1S134	5/3
AAY11	2/6	OA202	2/–	1N87A	4/6	1S940	1/–
AAZ15	3/3	1N34A	4/–	1N914	2/–		
BAY38	3/9	1N60	4/–	1844	1/8		
OA47	2/–	1N64	4/–	1S131	3/–		

VEROBOARD

	0·1	0·15
2½" × 5"	4/9	4/2
2½" × 3¾"	4/2	3/5
3¾" × 5"	5/6	5/6
3¾" × 3¾"	4/9	3/11
17" × 2½"	—	10/6
17" × 3¾"	—	14/8

Plain Veroboard (Uncoppered)
(0·15" Matrix only)

2½" × 5"	3/8
2½" × 3¾"	3/–
17" × 2½"	7/6
17" × 3¾"	9/8
17" × 5"	14/8
Cutter	7/3

Pin Insertion Tool	(0·1)	9/6
Pin Insertion Tool	(0·15)	9/6
Pkt. of 36 pins	(0·1)	3/11
Pkt. of 36 pins	(0·15)	3/11

INTERNATIONAL RECTIFIER HANDBOOKS

HB10	Rectifier Engineering Handbook	16/9
HB20	Zener Diode Handbook	16/9
HB30	Solar Cell & Photocell Handbook	16/9
HB40	SCR Handbook	20/–

PHOTOCELLS

IR CS-120	19/8
Mullard Type CRP12	9/–

ZENER DIODES

1S2030 Series (400MW, 3·3V to 15V)	4/8
Z1100-C Series (1W, 3·9V to 27V)	7/11

COMPONENTS CATALOGUE—2/–, Post Free (Inland) P. & P. 1/6 inland, overseas at cost (min. 10/–). Cash with order please, discounts may be deducted as follows: order over £5—10%: order over £10—15%. Trade orders—net 30 days. Please send S.A.E. with enquiries. **Callers Welcome.** Open 9.00 a.m. to 12.50 p.m., 2.00 p.m. to 5.00 p.m. Weekdays and Saturday Mornings 9.00 a.m. to 12.50 p.m.

Kinver ELECTRONICS LTD
STONE LANE KINVER
STOURBRIDGE WORCS
Telephone: KINVER 2099

Complete stereo system – £29.10.0

The new Duo general-purpose 2-way speaker system is beautifully finished in polished teak veneer, with matching vynair grille. It is ideal for wall or shelf mounting either upright or horizontally.

Type 1 SPECIFICATION:–
Impedance 10 ohms. It incorporates Goodmans high flux 6"×4" speaker and 2¼" tweeter. Teak finish 12"×6¾"×5¾". **4 guineas** each. 7/6d. p. & p.
Type 2 as type 1. Size 17½" × 10¾" × 6¾". Incorporating 10¼" × 6¼" bass unit and 2¼" tweeter. 3 ohms impedance **5½ guineas** plus 15/-p. & p. 7/6d. p. & p.
Garrard Changers from £7.19.6d. p. & p. 7/6d.
Cover and Teak finish Plinth £4.15.0d. 7/6d. p. & p.

Duetto **Integrated Transistor Stereo Amplifier** £9.10.0 **plus 7/6d. p. & p.**

The Duetto is a good quality amplifier, attractively styled and finished. It gives superb reproduction previously associated with amplifiers costing far more.
SPECIFICATION:–
R.M.S. power output: 3 watts per channel into 10 ohms speakers.
INPUT SENSITIVITY: Suitable for medium or high output crystal cartridges and tuners. Cross-talk better than 30dB at 1Kc/s.
CONTROLS: 4-position selector switch (2 pos. mono and 2 pos. stereo) dual ganged volume control.
TONE CONTROL: Treble lift and cut. Separate on/off switch. A preset balance control.

These 5 items can be purchased together for £29.10+£1.10 P.&P.

The Classic

Teak finished case

£9

Plus P. & P. 7/6

SPECIFICATION: Sensitivities for 10 watt output at 1KHz into 3 ohms. Tape Head: 3mV (at 3¾ i.p.s.) Mag. P.U.: 2 mV. Cer.P.U.: 80mV. Tuner: 100mV. Aux. 100mV. Tape/Rec. Output. Equalisation for each input is correct to within +2dB (R.I.A.A.) from 20Hz to 20KHz. *Tone Control Range: Bass:* 13dB at 60Hz. *Treble:* ±14dB at 15KHz. *Total Distortion:* (for 10 watt output) < 1·5%. Signal Noise: < −60dB. A.C. Mains 200–250V. Size 12½in long, 4¼in deep, 2¾in high. **Built and tested.**

The Viscount

INTEGRATED HIGH FIDELITY TRANSISTOR STEREO AMPLIFER

£14.5.0

Plus P. & P. 7/6

SPECIFICATION: *Output:* 10 watts per channel into 3 to 4 ohms speakers (20 watts monoral). *Input:* 6-position rotary selector switch (3 pos. mono and 3 pos. stereo). P.U., Tuner, Tape and Tape Rec. out. Sensitivities: All inputs 100mV into 1·8M ohm. *Frequency Response:* 40Hz–20KHz ±2dB. *Tone Controls:* Separate bass and treble controls. *Treble* 13dB lift and cut [at 15KHz]. *Bass:* 15dB lift and 25dB cut [at 60Hz]. *Volume Controls:* Separate for each channel. *A.C. Mains Input:* 200–240V, 50–60Hz. *Size:* 12½ × 6in × 2¾in teak-finished case. Built and tested. P. & P. 7/6.
Viscount Mark II for use with magnetic pick ups specification as above. Fully equalised for magnetic pick ups. Suitable for cartridges with minimum outputs of 4mV/cm/sec. at 1kc. Input Impedance 47k. **15 gns.** plus 7/6 P. & P.

THE RELIANT Mk. II

SOLID STATE GENERAL PURPOSE AMPLIFIER

£6.16.0 Plus P. & P. 7/6

In teak finished case

SPECIFICATION: *Output:* 10 watts into a 3 ohms speaker. *Inputs:* (1) for mike (10mV). Input (2) for gram. radio (250mV) individual bass and treble control. *Transistors:* 4 silicon and three germanium. *Mains input:* 220/250 volts. *Size:* 10¼ × 4¾ × 2¼in. *Mike to suit (crystal):* 12/6 plus 1/6 P. & P. 8 × 5in speaker 14/6 plus 3/– P. & P. Mk. I **5½ gns.** plus 7/6 P. & P. Less teak finished case.

SPECIAL OFFER

Complete stereo systems comprising BALFOUR 4 speed auto player with stereo head, 2 DUO speaker systems size 12 × 6¾ × 5¾in. Plinth (less cover) and the DUETTO stereo amplifier. All above items

£20 Plus P. & P. 20/–

NEW COMPLETE HI-FI STEREO SYSTEM

£39

Comprising SP 25 Garrard Mk. II with diamond stereo cartridge, Viscount amplifier Mk. I, Two type 2 speakers, Plinth and cover. **£39** plus £2 P. & P.

THE ELEGANT SEVEN Mk. III (350mW Output)

7-transistor fully tunable M.W.-L.W. Superhet portable. Set of parts. Complete with all components, including ready etched and drilled printed circuit board—back printed for foolproof construction. **MAINS POWER PACK KIT: 9/6 extra.**

Price £4.9.6 Plus P. & P. 7/6.

Circuit 2/6. Free with parts.

THE DORSET (600mW Output)

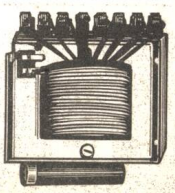
7-transistor fully tunable M.W.-L.W. Superhet portable with baby alarm facility. Set of parts. The latest modulated and pre-alignment techniques makes this simple to build. Sizes: 12 × 8 × 3in.
MAINS POWER PACK KIT: 9/6 extra.

Price £5.5.0 Plus P. & P. 7/6.

Circuit 2/6. Free with parts.

RADIO & TV COMPONENTS
R+TV
(ACTON) LIMITED

QUALITY MAINS TRANSFORMER



Input 250V OUTPUT (All RMS values) 4 windings of 11·5V connected in series total 46V at 4·5 amps (conservatively rated). The following combinations may be used. 1. 23—0—23V; 2. 46V. Both of these above voltages are commonly used in medium to high powered transistor amplifiers, power supplies, etc.

Price 35/- Plus P. & P. 7/6

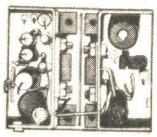
Also see opposite page

EXTRACTOR FAN

AC mains 230/250V. complete with pull switch. Size 6 × 6 × 4 in.

Price 27/6 Plus 7/6 P. & P.

X101 10W SOLID-STATE HI-FI AMP WITH INTEGRAL PRE-AMP



Specifications: *Power Output* (into 3 ohms speaker) 10 watts. *Sensitivity* (for rated output): 1mV into 3K ohms (0·33 microamp). *Total Distortion at* 1KHz. at 5 watts 0·35%, at rated output 1·5%. *Frequency Response:* Minus 3dB points 20Hz and 40KHz. *Speaker:* 3–15 ohms may be used). *Supply voltage:* 24V d.c. at 880mA (6–24V may be used).

Price 69/6 Plus 2/6 P. & P.

Control assembly: including resistors and capacitors.
1. Volume: PRICE 5/–.
2. Treble: PRICE 5/–.
3. Comprehensive bass and treble: PRICE 10/–.

The above 3 items can be purchased for use with the X101.

Power Supplies for the X101:
P101 M (for mono) 35/– plus 4/6 P. & P.
P101 S (for stereo) 42/6 plus 4/6 P. & P.

CAR TRANSISTOR IGNITION SYSTEM

(by famous manufacturer)

For 6V or 12V positive earth systems. Comprising: special high voltage working hermetically sealed silicon transistor mounted in finned heat-sink, high output ignition coil, ballast resistor and hardware (screws, washers etc.).

Price £4.19.6 (Post and Packing 5/- extra)

50 WATT AMPLIFIER A.C. Mains 200-250V

Price £28.10.0
Plus 20/- P. & P.

An extremely reliable general purpose valve amplifier. Its rugged construction yet spage age styling and design makes it by far the best value for money. **TECHNICAL SPECIFICATIONS** 3 electronically mixed channels, with 2 inputs per channel, enables the use of 6 separate instruments at the same time. The volume controls for each channel are located directly above the corresponding input sockets. **SENSITIVITIES AND INPUT IMPEDANCES.** Channels 1 & 2 4mV at 470K. These 2 channels (4 inputs) are suitable for microphone or guitars. Channels 3 & 4 300 mV at 1m. Suitable for most high output instruments (gram, tuner, organ etc.). Input sensitivity relative to 10w output. **TONE CONTROLS ARE COMMON TO ALL INPUTS. Bass Boost** +12dB at 60 Hz/s. **Bass Cut** −13dB at 60 Hz/s. **Treble Boost** +11dB at 15 KHz/s. **Treble Cut** −12dB at 15KHz/s. With bass and treble controls central −3dB points are 30Hz/s and 20 KHz/s. **POWER OUTPUT.** For speech and music 50 watts rms. 100 watts peak. For sustained music 45 watts rms. 90 watts peak. For sinc wave 38·5 watts rms. Nearly 80 watts peak. Total distortion at rated output 3·2% at 1KHz/s. Total distortion at 20 watts 0·15% at 1KHz/s. Output to match into 8 or 15 ohms speaker system. **NEGATIVE FEED BACK** 20dB at 1KHz/s. **SIGNAL TO NOISE RATIO** 60dB. **MAINS VOLTAGES.** Adjustable from 200–250V. A.C. 50–60Hz/s. A protective fuse is located at the rear of unit. Output impedance 3, 8 and 15 ohms.

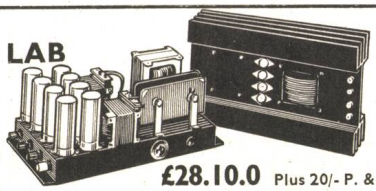
THREE-IN-ONE HI-FI 10 WATT SPEAKER

A complete Loud Speaker system on one frame, combining three matched ceramic magnet speakers with a low loss cross over network. Peak handling power 10 watts. Impedance 15 ohms. Flux density 11,000 gauss. Resonance 40–60 c/s. Frequency range 50c/s to 20kc/s. Size 13½ × 6⅛ × 4½ inches. By famous manufacturer.

List Price £7. **Our Price 74/6** Plus 5/- P. & P.

Similar speaker to the above without tweeters in 3 and 15 ohms 44/6 plus 5/- P. & P.

LIVINGSTONE LAB



50 watt RMS Base Transistor Amplifier. This amplifier is designed and manufactured by L.L. using the best quality components, thus making it extremely reliable and almost indestructible. Size (Power supply) 16×9¼ × 6½in. (Amplifier) 14½ × 9 × 4in; sensitivity for rated output 1V.

£28.10.0 Plus 20/- P. & P.

TERMS C.W.O.
All enquiries S.A.E.

RADIO & TV COMPONENTS
R+TV
(ACTON) LIMITED

RECORD PLAYER SNIP A.C. MAINS 240V

The "Princess" 4-speed automatic record changer and player engineered with the utmost precision for beauty, long life, and trouble free service. Will take up to ten records which may be mixed 7in to 10in or 12in. Patent stylus brush cleans stylus after each playing and at shut off, the pick-up locks itself into its recess, a most useful feature with portable equipment—other features include pick-up height adjustment and stylus pressure adjustment. This truly is a fine instrument which you can purchase this month at only **£5.19.6** complete with cartridge and ready to play.

Only £5.19.6 Post and insurance 7/6 extra.

STEREO PRE-AMPLIFIER

Inputs—6 position rotary switch (3 position mono, 3 position stereo). Tuner 150 mV into 680k. Magnetic pick-up fully equalised and suitable for magnetic cartridges with minimising output of 4mV/cm/sec. Load 47k. Ceramic pick-up 150 mV into 680k. Sensitivities taken for 200mV output. Controls—separate volume controls for each channel. Twin ganged bass, 12dB lift and 15dB cut at 60c/s. Twin ganged treble, 10dB lift and 15dB cut at 10kc/s. Voltage required 23-30v D.C. at 5mA. Size 12½" × 3½" × 2¾". In teak finished case, complete with front panel and knobs. Built and tested.

Price £7.7.0 Plus 5/- P. & P.

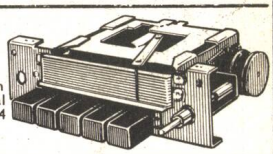
CYLDON 2 TRANSISTOR U.H.F. TUNER

Brand new. Complete with circuit diagram.

Price £2.10.0 Plus 1/- P. & P.

PYE CAR-RADIO

PUSH BUTTON TUNING HEART



This PRESTOLOCK 5 station Push-Button Tuner Heart with Manual Over-ride is an ideal basis for a quality AM car radio. Size 6½ × 4 × 2in. **25/-** Plus 3/- P. & P.

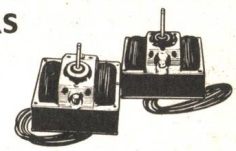
POCKET MULTI-METER

Size 3⅞ × 2⅛ × 1⅜in. Meter size 2⅛ × 1⅜in. Sensitivity 1000 O.P.V. on both A.C. and D.C. volts. 0–15, 0–150, 0–1000 D.C. current 0–150mA. Resistance 0–100k Ω. Complete with test prods. battery and full instructions.

Price 42/6 Plus 3/6 P. & P.

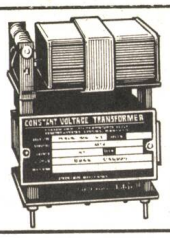
FREE GIFT for limited period only. 30 watt Electric Soldering Iron value 15/– to every purchaser of the Pocket Multi-Meter.

GARRARD TAPE MOTORS



Fast forward and fast re-wind motors, as used by famous manufacturer. Size 3 × 2½ × 2¾in. Spindle $\frac{5}{32}$in. A.C. Mains 250V.

39/6 per pair Plus 7/6 P. & P.

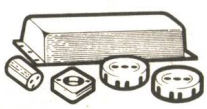


ADVANCE CONSTANT VOLTAGE TRANSFORMER

Output 7·5V at 1 amp and 30V at 100MA. Mains input 125V (2 can be used in series for 250V).

Price 22/6 Plus 7/6 P. & P.

40W FLUORESCENT LIGHT KIT



Incorporating **GEC** Choke size 8¼ × 1¾ × 1¾in, 2 bi-pin holders. starter and starter-holder. P. & P. 5/6. **11/6**

Similar to above: 80W. Fluorescent Light Kit incorporating **GEC** choke size 11¾ × 1¾ × 1¾in. 2 bi-pin holders, start and starter holder. P. & P. 6/6. **17/6**

B.S.R. TD2 TAPE DECK

This tape deck takes 5¾in spools complete with two-track heads. Size 13¾in long by 8¾in wide.

Price £8.19.6 Plus P. & P. 7/6.

Goods not despatched outside U.K.

RADIO & TV COMPONENTS (ACTON) LTD.

21d High Street, Acton, London, W.3

Also at 323 Edgware Road, London, W.2

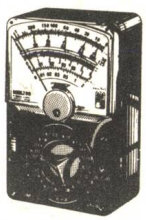
ALL ORDERS BY POST TO OUR ACTON ADDRESS

Lasky's

LASKY'S EXCLUSIVE TMK METER KITS

These two meter kits by TMK offer the unique opportunity of building a really first-class precision multimeter at a worthwhile saving in cost. The cabinets are supplied with the meter scale and movement mounted in position; the Model 200 also has the range selector in position. The highest quality in components and 1% tolerance resistors are used throughout. Both offer professional standards of accuracy. Supplied complete with full constructional, circuit and operating instructions.

MODEL 200



20,000 O.P.V. Multimeter. Features 24 measurement ranges with mirror scale. Large 3 × 2in meter. Full scale accuracy: DCV and current: ±2%, ACV: ±3%, resistance ±3%. Special 0·6V DC range for transistor circuit measurements.

SPECIFICATION

● DCV: 0-0·6-6-30-120-600-1,200V at 20K/OPV. ● ACV: 0-6-30-120-600-1,200V at 10K/OPV. ● DC Current: 0-0·6-6-60-600mA. ● Resistance: 0-10K-100K-1M-10M/ohms (58-580-5·8K-58K at mid-scale). ● Capacitance: 0·002-0·2uf (AC 6V range). ● Decibels —20 to +63dB. ● Output: 0·05uf blocking capacitor. Uses two 1·5V (U.7 type) batteries. Black bakelite cabinet—Size 5¼ × 3¾ × 1¾in. Complete with test leads.

LASKY'S PRICE 85/- Post 3/6

MODEL 5025

50,000 O.P.V. FEATURING 57 MEASUREMENT RANGES

Uses an entirely new range selection mechanism which permits the use of a really large meter in a more compact cabinet. The range selected is clearly indicated on the actual meter face. High speed rotary range selection knob; also features polarity reversal switch, shielded meter movement with overload protection circuit; Special uA and mA measurement ranges.

SPECIFICATION DCV: 0-0·25-2·5-10-50-250-1,000V at 25K/OPV. 0-0·125-1·25-5-0-25-125-500V at 50K/OPV. ACV: 0-3-10-50-250-1,000V at 2·5K/OPV. 0-1·5-5-25-125-500V at 5K/OPV. DCuA: 0-25uA at 125mA: 0-50uA at 250mA. DCmA: 0-2·5-25-250mA at 125mV; 0-5-50-500mA at 250mV. DC Amps: 0-5A at 125mV; 0-10A at 250mV. Resistance: 0-10M/ohms. Output: Capacitor (0·1uF, 400Vw) in series with ACV ranges. Decibels: —20 to +81·5db. Operates on two 1·5V batts. Black bakelite cabinet, size 5¼ × 6¾ × 2¾in. Complete with test leads.

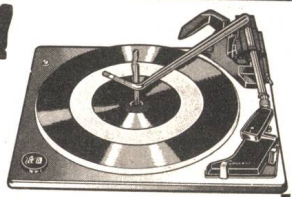
LASKY'S PRICE £10.10.0 Post 5/-

ALSO AVAILABLE READY BUILT AND TESTED £12.10.0. Post 5/-

Garrard

SL.55

4-speed autochanger with stereo cartridge



LASKY'S PRICE £11.19.6 Post 5/-

Complete with AD76K MAGNETIC CARTRIDGE £16.9.6

AUTOCHANGERS

1025 less cartridge	£6 9 6
1025 with GCM21 mono cartridge (Stereo Compat) ..	£6 19 6
2025TC with 9TA stereo diamond cartridge	£8 17 6
SL65B less cartridge	£15 19 6
AT60 Mk. II less cartridge ..	£13 5 0
SL75 less cartridge	£28 10 0
SL95 less cartridge	£35 0 0
A70 Mk. II less cartridge ..	£13 19 6
B.S.R.UA-47 less cartridge ..	£5 9 6

SINGLE PLAYERS

AP75 with AD76K magnetic cartridge	£21 0 0
AP75 less cartridge	£18 10 0
SP.25 Mk.II less cartridge ..	£11 19 6
SRP22 Mains model less cartridge	£6 12 10
SRP23 Battery model less cartridge	£7 15 8
TRANSCRIPTION DECK 401	£28 10 0

GARRARD BASES:

WB1 £3. 6. 11; WB4 Mk. II £5. 8. 11; WB5 £5. 8. 11.

CLEARVIEW PERSPEX COVERS:

SPC1 £3. 5. 0 SPC4 Mk. II £4. 6. 6.

Postage on all above 5/- extra

GET YOUR LASKY'S AUDIO-TRONICS PICTORIAL

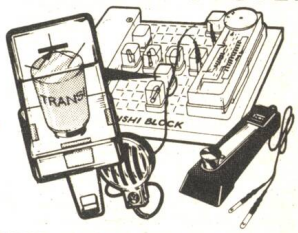
16 colour pages in large 16×11in. format packed with 1,000's of items from our vast stocks. Hi-Fi, Radio, Electronics, Test equipment, Components, etc., etc.

Send 1/- for post only and inclusion on our regular mailing list. (5/- overseas)

DENSHI BOARD KITS

EXPERIMENTAL AND EDUCATIONAL CIRCUIT SYSTEM

The **DENSHI BOARD** system enables the young experimenter and electronics hobbyist to produce a wide range of transistor circuits of increasing sophistication—without soldering or the use of any tools at all! Basically the system comprises a slotted circuit board into which plug-in components and bridge pieces are set to produce up to 30 different circuits. The components are encapsulated in transparent plastic blocks bearing the appropriate circuit symbol and value thus enabling even the complete novice to visually grasp the fundamentals of circuitry after only a few moments study. **DENSHI BOARD KITS comes complete with an 80 page manual of circuits and data. Manuals are available separate at *4/6 post 6d. *Refundable if you purchase kit.**



***THESE ARE JUST A FEW OF THE CIRCUITS YOU CAN BUILD IN MINUTES:* VARIOUS RADIO RECEIVERS, AMPLIFIERS, MORSE CODE PRACTICE DEVICE, CONTINUITY TESTER, SIGNAL INJECTOR, SIGNAL TRACER, WIRELESS MICROPHONE, ETC., ETC.**

DENSHI BOARD KIT SR-1A *comprises:*

Base board; tuner block; 4 resistors; choke coil; transformer; 2SA transistor for RF; 2 diodes; 3 capacitors; battery block; morse key; antenna lead; crystal earphone; various bridge and connecting pieces **This kit permits the building of 16 basic circuits.**

LASKY'S PRICE £4.19.6 Post 3/6

DENSHI KIT SR-2A *as SR-1A with these additional parts:*

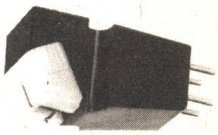
2SB transistor for AF; 2 resistors; 1 capacitor; crystal microphone; test probes; electrode; additional connecting pieces; 9V battery. **This kit permits the building of 30 circuits**

LASKY'S PRICE £7.2.6 Post 3/6

SPECIAL HI-FI OFFER

AD-86K STEREO MAGNETIC CARTRIDGE

The famous AUDIO DEVELOPMENT AD-86K high compliance stereo magnetic cartridge now at our "all time low" special price offers you the opportunity of obtaining magnetic pickup quality for your hi-fi at a price you can afford. Brief Spec : Diamond L.P. stylus Compliance 10 × 10^{-6}cm/dyne. Frequency response 20-20KHz. Channel separation 25dB. Output 5mV. Tracking pressure 3gm ± 0·5gm. Standard ½in mounting. (Replacement stylus available.) Don't miss this great chance. **List Price £6.2.6.**



SPECIAL PRICE 69/6 Post 2/6

Replacement diamond stylus EN30S **39/6.**

SKYROVER MK II

COMMUNICATION RECEIVER

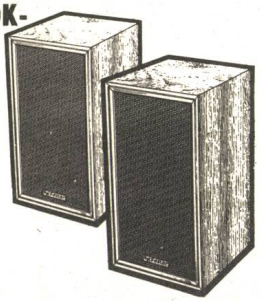
A short wave receiver, exclusive to Lasky's, at a real economy price. Four valve line up using one each 6BE6, 6BA6, 6AV6 and 6AR5 valves, gives highly sensitive reception and powerful gain. Switch selected SW frequency range cover: 1·5 to 30Mc/s in three separate bandspread ranges and full AM medium waveband cover in one range 550-1,600Kc/s. Reduction drive tuning with hair line cursor. Controls include volume on/off BFO, Band selector. Power on indicator lamp. External antenna connections and mains fuse at rear. Internal speaker plus standard 5mm jack socket for phones on front. For 220/240V a.c. mains operation. Strong metal cabinet finished in grey crackle with anodised silver front panel. Size 9½ × 5¼ × 5¼in. Complete with mains lead and full instructions.

LASKY'S PRICE £13.13.0 Post 5/-

Lasky's

NEW FOSTER "Criterion" Mk II

2 SPEAKER TWO WAY BOOK-SHELF SPEAKER SYSTEM

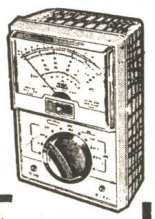


Another high quality sub-miniature book-shelf system from Foster. The "Criterion" Mk II is a sealed infinite baffle type enclosure using 5½in bass/mid-range woofer with rolled cloth edge and a 2½in HF cone type tweeter. The compact cabinet is constructed ½in laminate with handsome oiled walnut veneer finish and black woven acoustic gauze front panel with satin chrome edge insert. SPEC: Frequency range 90-20,000Hz. Power handling 10 watts. Impedance 8 ohms. HF crossover. Screw tag connections at rear. Size 12½ × 7¾ × 6¾in. The performance of the "Criterion" is superior to many larger and more expensive units and at Lasky's exclusive price offers absolutely unbeatable value.

Post 1—7/6
2—12/6

LASKY'S PRICE £9.10/- or 2 for £17.10/-

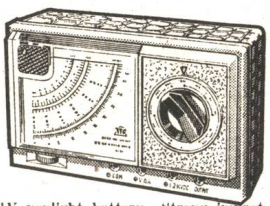
TTC MODEL C-1000



A really tiny 1,000 O.P.V. pocket multi-tester with "big" meter performance. Precision 2 jewel meter movement. Hand calibrated to ±3% accuracy on full scale of DC ranges, 4% on AC ranges. 2½in square meter. SPECIFICATIONS AC/V ranges: 0-10, 50, 250 100V at 1K/O.P.V. DC currents: 0-1-100mA. Resistance: 0-150K/ohms (3,000 ohms centre scale). Decibels: —10 to +22dB. Operated on one penlight cell. Two colour buff/green case—size only 3¼ × 2¾ × 1in. Click stop range selection switch. Ohms zero adjustment.. Complete with test leads, battery and instructions with circuit data.

LASKY'S PRICE 39/6 Post 2/6

TTC MODEL C-1051



20,000 O.P.V. pocket multimeter with mirror scale and built in thermal protection circuit. Exceptionally large easy to read meter with D'Arsonval movement. Colour coded scales. Single positive click-in, recessed selection switch for all ranges. Ohms zero adjustment. Range spec. A.C. volts: 0-6-30-300-1200V at 10/K/ohms/V. D.C. volts: 0-3-15-150-300-1·2KV at 20K/ohms/V. Resistance: 0-60K-6megs. D.C. current: 0-60μA-300mA. Decibels: —20dB to +17dB. Hand calibration gives extremely high standard of accuracy on all ranges. Uses one 1½V penlight battery. Strong impact resistant plastic cabinet—size only 4¾ × 3¼ × 1¼in. Two colour buff/green finish. Complete with test leads and battery. **Original list price 5gns.**

LASKY'S PRICE 75/- Post 2/6

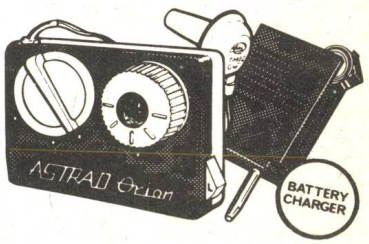
TMK PL-436

20,000 O.P.V. Multitester for the amateur or professional. Features mirror scale and wood grain finish front panel. Spec.: D.C./V ranges: 0·6, 3, 12, 30, 120, 600V at 20K/O.P.V. A.C./V ranges: 3, 30, 120, 600V at 8K/O.P.V D.C. current: 50μA, 0·6, 60, 600mA. Resistance: 10K, 100K, 1M and 10M ohms end scale (65, 650, 6·5K and 65K ohms centre scale). Decibels: —20 to +57dB in four ranges. Operates on 2 × 1·5V U7 type batteries. Size: 5¼ × 4½ × 2¾in. Complete with test leads, batteries and instructions.

LASKY'S PRICE £6.19.6 Post 5/-

SCOOP! THE WORLD'S SMALLEST 6 TRANSISTOR TWO WAVEBAND RADIO RECEIVER

THE Astrad ORION



Made to the highest space-age standards — this remarkable micro-size set measures only $1^{11}/_{16} \times 1^{3}/_{10} \times {}^{5}/_{16}$in. yet it contains 6 transistors and other components combined in a photo etched circuit, only ¾ × ½in.: tuning capacitor, ferrite rod aerial, battery, wave band selection switch etc. Output to a high impedance crystal earpiece, giving ample volume (automatically adjusted) and clear tone. Brief tech. spec.: Waveband coverage—Medium wave 525 to 160 kc/s, Long wave 150 kc/s to 408 kc/s. Sensitivity: 35MV max. Selectivity —10dB (at 30 kc/s dc-tuning). Power source: 1 × 1·4V Mercury battery.

The Orion is supplied fully built and tested complete with battery, left and right fitting earphone supports and attractive black and ivory plastic presentation/carrying case (matching the Orion). Never miss your favourite music, sport, news—the Orion is an ideal gift for all, providing a constant source of enjoyment without disturbing others.

LASKY'S PRICE ONLY 39/6 Post 2/6 Extra rechargeable battery 3/6

*NOTE: The battery we supply with the Orion is a rechargeable type. Charger units are available enabling you to re-charge the battery from AC Mains 220/240V supply.

PRICE 19/6 extra. Post free with radio—otherwise 2/-

MIDLAND Model 10-502 VHF AIRCRAFT BAND CONVERTER

An entirely new item for the radio enthusiast bringing instant reception of the ground-to-air, air-to-ground waveband. For use with any standard AM or FM radio covering 535 to 1605Kc/s, 88 to 108Mc/s respectively—with no electrical conversion or connection required. The Model 10-502 self powered by one 9V (PP3 type) battery is merely placed close to the receiving set and then tuned over 110 to 135Mc/s which covers the whole aircraft communications band. Volume and reception effectiveness is adjusted by moving both sets to the most favourable position and balancing the vol. controls of each accordingly. The Model 10-502 has a smartly designed black plastic cabinet with brushed metal front panel and 18in. chrome telescopic antenna, size only 4 × 2⅞ × 2⅜in. (inc. knobs). Complete with battery and full instructions.

LASKY'S PRICE 79/6 Post Free

NEW INTERNATIONAL TAPE

FAMOUS AMERICAN MADE BRAND TAPE at RECORD LOW PRICES

3in	Message tape, 150ft	2	6
3in	Message tape, 225ft	3	9
3in	Message tape, 300ft	7	6
3½in	Triple play, 600ft Mylar	10	0
4in	Triple play, 900ft Mylar	17	6
5in	Double play, 1,200ft Mylar	15	0
5in	Long play, 900ft Acetate	10	0
5in	Standard play, 600ft PVC	8	6
5in	Triple play, 1,800ft Mylar	35	0
5½in	Double play, 1,800ft Mylar	22	6
5½in	Long play, 1,200ft Acetate	12	6
5½in	Standard play, 850ft PVC	11	6
5½in	Long play, 1,200ft Mylar	15	0
5½in	Triple play, 2,400ft Mylar	45	0
7in	Standard play, 1,200ft Acetate	12	6
7in	Standard play, 1,200ft Mylar	12	6
7in	Long play, 1,800ft Mylar	19	6
7in	Double play, 2,400ft Mylar	25	0
7in	Long play, 1,800ft Acetate	15	0
7in	Triple play, 3,600ft Mylar	50	0

P. & P. 1/- extra per reel. 4 reels and over Post Free. **Special quotes for quantities.**

NEW BUDGET PRICED CASSETTES from the U.S.A.

C.60—7/6 (6—42/6) C.90—12/6 (6—70/-) C.120—17/6

Post 1/- each. 4 and over Post Free. **Special quotes for quantities.**

Lasky's Radio Limited

LASKY'S RADIO ESTABLISHED OVER 36 YEARS

Branches

207 EDGWARE ROAD, LONDON, W.2 Tel.: 01-723 3271

33 TOTTENHAM CT. RD., LONDON, W.1 Tel.: 01-636 2605

Open all day, 9 a.m.—6 p.m. Monday to Saturday

152/3 FLEET STREET, LONDON, E.C.4 Tel.: 01-353 2833

Open all day Thursday, early closing 1 p.m. Saturday

High Fidelity Audio Centres

42-45 TOTTENHAM CT. RD., LONDON, W.1 Tel.: 01-580 2573

Open all day, 9 a.m.—6 p.m. Monday to Saturday

118 EDGWARE ROAD, LONDON, W.2 Tel.: 01-723 9789

Open all day Saturday, early closing 1 p.m. Thursday

ALL MAIL ORDERS AND CORRESPONDENCE TO: 3-15 CAVELL STREET, TOWER HAMLETS, LONDON, E.1 Tel.: 01-790 4821

Sonotone 9TA and 9TA/HC. Diamond Cartridge brand new, boxed in manufacturers' carton **49/6** plus 2/6 p/p. **Acos** GP 91-1 and GP 91-3 stero compatible cartridges, new in sealed manufacturers' cartons **22/6** plus 2/6 p/p.

BASF TAPE 25% OFF

5in	600ft.	14/-	900ft.	19/-	1200ft.	30/-
5¾in	900ft.	19/-	1200 ft.	24/-	1800ft.	39/-
7in	1200ft.	24/-	1800ft.	35/-	2400ft.	57/-

P/P 2/- per reel—over £5 FREE

SPECIAL PURCHASE
12in 15watt HI-FI LOUDSPEAKERS

Made by famous British manufacturer to very high standards, heavy duty cast chassis, twin cone construction, smooth extended range, with very low level of distortion.—Response 35–17,500Hz.—impedance 15 ohms—flux, 11,000 gauss.

WALDON PRICE 97/6 each plus 6/6 P. & P.

E.M.I. HI-FI SPEAKERS

SET 450: 13×8 with two built-in tweeters and cross-over unit. **Our Price 69/6.** 3 or 15 ohm, 10W, 40-13,000Hz.

SET 850: 6½in bass plus 3¾in tweeter and cross-over unit. 8 ohm, 10W, 65-20,000Hz. **79/6.**

SET 250: 5in heavy duty bass plus 3in tweeter and cross-over unit. 8 ohm, 6W, 80-20,000Hz. **65/-**

Add 5/6 p/p for each speaker set.

TRIO Stereo Moving Magnet Cartridge Model AD76K. Diamond Stereo LP Stylus. Frequency response 20-20,000c/s output. 7mV tracking pressure 2 grammes ± 0·5 grm. Fully guaranteed. Price **85/-** p/p free.

GARRARD UNITS

	£	s	d
SP25 Mk. II	11	9	6
AP75	17	19	6
SL65	14	9	6
***3500**	11	9	6

***Denotes** including Sonotone 9TA-Stereo/Diamond Cartridge. Elegantly styled plinth and cover to suit the above units. From **5 gns.** Please add 10/- p/p each on all above items.

SPEAKER ENCLOSURES

Designed to accept the full range of E.M.I. loudspeakers. Beautifully styled in teak.

Prices from 89/6 each.

25 WATT GROUP SPEAKERS

Guitar group 25. 12in round, heavy duty cone, with solid aluminium chassis, 15 ohms imp. 12,000 gauss. Response 30-10,000c/s. OUR SPECIAL PRICE

£.5.9.6 plus 6/6 P. & P.

The greatest budget system available today—can't be beaten—price or quality anywhere—look at these great features—then compare:

	£	s	d
Teleton FZ000 Mk. II. Tuner amp. Latest version with all the new features. Tuning indicator—fused circuit protection, AM-FM fitted multiplex, A.F.C. 2×5 watts per channel. A truly outstanding unit.	43	1	8
Garrard 3500 (Auto/single). Latest in the great new Garrard range, provides facilities and controls that are usually found only on much more expensive units	13	11	0
Teleton SA1003 matching speaker systems	10	0	0
Sonotone 9TA stereo cartridge with diamond styli—a perfect match	4	2	0
Plinth/Cover elegantly styled	7	0	0
Plugs and Leads all supplied	1	5	0
Normal Retail Price	£78	19	8

Exclusively offered by WALDON at the remarkably low price of 63 gns +25/- Carrg.

All items may be purchased separately.

WALDON ELECTRONICS, 707 Blackburn Road, Bolton, Lancs. Bolton 54280

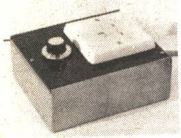
PLEASE ENCLOSE 1/0 IN STAMPS WITH ENQUIRIES

AUDIO EFFECTS

5 SHAW LANE HALIFAX YORKS.

Buy with confidence and obtain the right results. Refunds without question if any of our products fail to give 100% satisfaction.

REVERBERATION AMPLIFIER. Self-contained transistorised battery operated. An entirely different approach to sound reproduction. Normally sound reproduction from a single source has a flat, one-dimensional effect. With this unit proper sound delay through reverberation, tones are created with a truly third dimension for concert hall originality. Two controls adjust volume and reverberation. Simply plug microphone, guitar, etc. in and the output into your amplifier. Supplied in a beautiful walnut cabinet. 7¼×3×4¼in. **£10.4.0.** P.P. & Ins. 6/-.



POWER CONTROLLER. Power at your finger tips. Not merely half wave control but full wave. A single variable control gives zero to full power. Uses latest 15amp 3kW triac and special triggering device. Ideal for all types of lighting, fires, motors, drills, etc. Complete with box, power socket, cables, etc. In kit form with easy to follow instructions **£6.9.6.** Ready built **£9.4.6** plus 5/6 P.P. & Ins.

VOX SWITCH. This sound operated switch is ideal for mobile TX work, tape recorder switching, etc. You speak, it switches. High and medium imp. inputs. AF take off point. Drives your 12 volt relay. In kit form with full instructions, **42/6.** Ready built, tested and guaranteed, **62/6** plus 2/6 P.P.

METRONOME UNIT. Variable beat. Listen while you play and keep in time. Easily built, pocket size with personal mini earphone. In kit form **27/6** post paid. Ready built in an attractive black and white polythene case **37/6** post paid.

MORSE OSCILLATOR. PC board, transistors, high stab. components, battery carrier, ear piece. Adjustable tone. Just attach your key. Drives phones or speakers. In kit form **17/6** post paid. Ready built in similar case as above, **25/-** post paid.

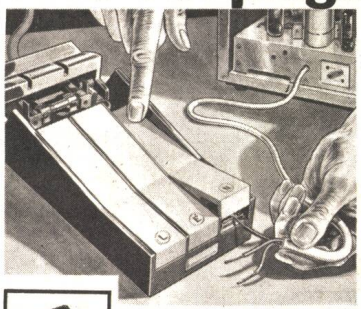
JUST ARRIVED IN STOCK. Texas transistors. Complementary symmetry. Driver, NPN, PNP output. The set of three ONLY **6/6** post paid.

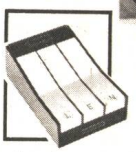
Free lists with every order. For lists only send 1/6 *(deductable from first order).*

MAINS Keynector

A REVOLUTIONARY NEW PRODUCT

cuts out plugs





SAFEST & QUICKEST WAY TO CONNECT ELECTRICAL EQUIPMENT TO THE MAINS

No plugs—no sockets—no risk of bare wires. To connect anything electrical, from an oscilloscope to an electric drill, simply open the fuse housing, depress the keys, insert the wires and close the housing. A neon light on the front of the Keynector glows to indicate proper connection. Multi-parallel connections can be made up to 13 amps. Keys are colour coded and lettered LEN for quick identification. The Keynector casing is in two-tone plastic and measures 5 x 3 x 1¼in. Please send for further information.

E.B. INSTRUMENTS

DIVISION OF ELECTRONIC BROKERS LTD.

49-53 PANCRAS ROAD, LONDON, N.W.1

Telephone 01-837 7781

CRESCENT RADIO LTD.

(electronic component specialists)

For all regular components try

40 Mayes Road, Wood Green, N.22

For surplus components and equipment try

11 Mayes Road, Wood Green, N.22

BARGAIN COMPUTER BOARDS

Assorted Components mounted on boards all with long tags. Ideal for breaking down and experimenting with. Take advantage of bulk purchase

1 Board	2/- each
20 Boards	20/-

PRINTED CIRCUIT BOARD

8×6 inch One Sided Board .. 2/- each

TRANSISTOR RADIO PANEL

Incomplete Min. Radio Panel; I.F.T.s; Transistors; Resistors; Capacitors; All for 2/- per panel.

COMPONENT BARGAINS

S.P. Flick Toggle Switch, 2in. Dolly	3/6 each
250V 2 amp. Toggle Switch	1/6 each
4 Pin Transistor Holders	6d. each
1in. Spun Aluminium Knobs, ¼in Spindle	2/6 each
OC19 Power Transistor	5/- each
Low Impedance Transistor Earpiece	1/6 each
2½in 8ohm Loudspeaker	5/6 each
Continental Razor Adaptor Kit	7/6 each
100mF 6V d.c. Transistor Capacitor	9d. each
500mF 6V d.c. Transistor Capacitor	1/- each
6,800pF Mullard Capacitor 400V d.c.	6d. each

We have large stock of

Veroboard; Valves; Transistors; Loudspeakers; Auto-Changers; Recording Tape; Cable; Hi Fi

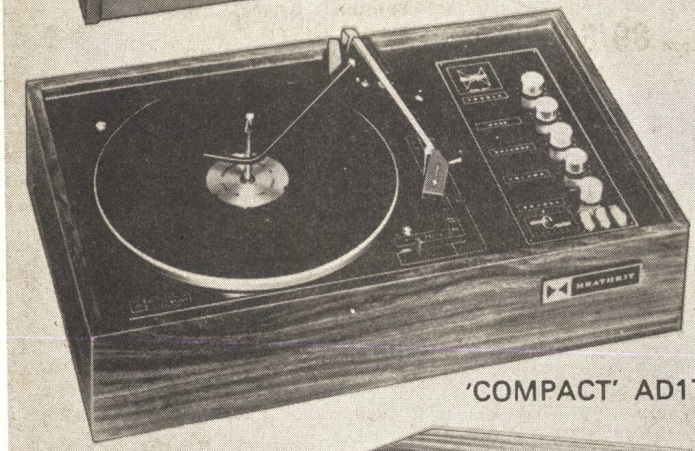
Send **1/6d** *for Our Catalogue*

Postage with order please

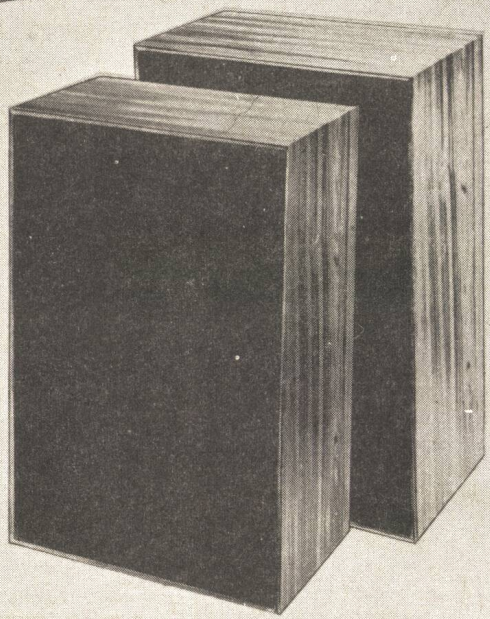
The International Sound of the 70's

IS THE HEATHKIT 'COMPACTS' AND LOUDSPEAKERS

'COMPACT' AD27



'COMPACT' AD17



AMBASSADOR SPEAKERS

The Fabulous Stereo "Compacts", Models AD-17 and AD-27 are setting the pace in hi-fi for the 1970s. They offer outstanding value and performance.

The AD-17 comprises a BSR MA-65 turntable/Shure M44-MB magnetic cartridge and a 10 watt (R.M.S.) per channel stereo amplifier—all mounted on a teak or walnut plinth. **Total kit price, £54.** carr. 13/-.

The AD-27 is similar but uses the MA-70 turntable and includes an F.M. stereo tuner. In this case the "plinth" is better described as a small cabinet. It has the additional feature of a "roller shutter" lid and is available in teak or walnut. **Total kit price, £82.** Carr. 13/-.

Heathkit offer many excellent loudspeaker systems. The new "Ambassador" Hi-Fi Loudspeaker is winning many friends. Its cabinet is supplied ready assembled and finished in selected teak or walnut veneers to harmonise with other current Heathkit hi-fi equipment. It uses three loudspeaker units, a 12in bass, 5in mid range and a 1in dome pressure tweeter. Excellent value at **£29.16.0.** Carr. 15/-.

The complete Heathkit Hi-Fi range of stereo amplifiers, tuner/amplifiers, F.M. tuners, stereo "compacts", loudspeaker systems and ancillary hi-fi equipment are all described and illustrated, many in full colour, in a wonderful free catalogue.

Send for the FREE Catalogue and see for yourself . . . Today!

To: DAYSTROM LTD., GLOUCESTER GL2 6EE
Please rush me details of the latest Heathkit Hi-Fi models

NAME .....

ADDRESS .....

P.E. 1B

HEATHKIT **DAYSTROM LTD.**

HEATHKIT DIVISION
GLOUCESTER GL2 6EE

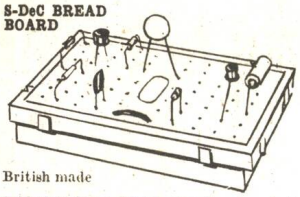
Telephone: GLOUCESTER 2945 **Telex 43216**

LIND·AIR OPTRONICS LTD

TTC.C1001 MULTITESTER in leather case. Overload protection. 20,000 opv. AC volts 10, 50, 250, 1,000V. DC volts 5-25, 125, 500, 2,500V. D.C. Current 0–50μA, 0–250mA Resistance 0–60K, 0–6 Megohm. Decibels —20 to +22dB. Size of meter 4½ × 3½ × 1in. **85**/–. P. & P. 3/6.

SHIRA 62D MULTI-TESTER 20,000 o.p.v. DC voltage: 5-25-50-250-500-2·5K (20,000 ohms per volt). AC Voltage: 10-50-100-500 1000 volts (10,000 ohms per volt). DC Current: 0-50μA, 0-2·5mA, 0-250mA. Resistance: 0-6K, 0-6Mg (300 ohm and 30K at centre scale). Capacitance: 10pf. to ·001 mfd, ·001μf to ·1μF. Decibels: —20 to +22dB. Size 4½ × 3½ × 1in. Complete with case **77**/–. P. & P. 3/6.

S-DeC BREAD BOARD



British made

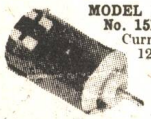
Solderless breadboard panels, for fast reliable component connections.
Single DeCs. One S-DeC with Control Panel, Jig and Accessories for solderless connections to controls, etc., with booklet "Projects on S-DeC" giving construction details for a variety of circuits. **29/6.** P. & P. 2/6.
4-DeC KIT. Four S-DeCs wth two Control Panels, Jigs and Accessories and the booklet "Projects on S-DeC" all contained in a strong attractive plastic case. Ideal for the professional user. **£5.17.6.** P. & P. 3/6.

GARRARD DECKS

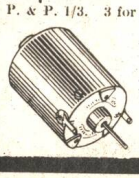
SRP22 less cartridge **£5. 9.6**
1025 Stereo/Mono with cart. **£6.19.6**
2025 Stereo/Mono with cart. **£7.19.6**
3000S Stereo/Mono with cart. .. **£9.19.6**
3000D Stereo/Mono with cart. .. **£10.19.6**
SP25 less cartridge **£11.19.6**
SP25 with Decca Deram cart. .. **£17. 4.6**
SL55 less cartridge **£11.19.6**
SL55 with Decca Deram cart. .. **£17. 4.6**
SL65 less cartridge **£14. 9.6**
Covers for above **£2.19.6**
Bases for above **£2.10.0**
AP75 less cartridge **£18.18.0**
SL75 less cartridge **£28. 7.0**
SL95 less cartridge **£38.19.6**
Bases for above **£4.19.6**
SPECIAL OFFER!
SP25 less cart., with base **£13.10.0**
P. & P. Decks 12/6, Cover 4/6, Base 4/6.
P. & P. Deck/Cover/Base 17/–.

SPECIAL OFFER!

Sonotone 9TAHC Stereo Cartridge with diamond styli. Normal retail price 4gns.
Our Price 55/–. P. & P. 1/6.
Suitable for use with all Garrard Decks.

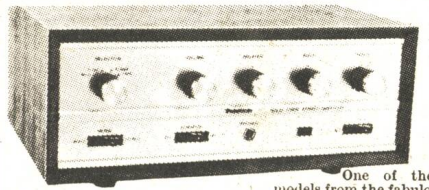


MODEL MAKER'S MOTOR No. 15RN. Voltage 11·5V. Current 400mA. Torque 12g.cm. Body size 1⅜" × long × ⅞" dia. Shaft 3/16" long × ¼" dia. Ideal for small models and toys. **5/6** each.
P. & P. 1/3. 3 for **15**/–. P. & P. 2/6.



9V d.c. Gram deck replacement motor. 2in × 1⅛in dia. Shaft ⅛in long × 3/32in. **17/6.** P. & P. 2/–. Two for **30**/– P. & P. 2/–.

SPECIAL LIND-AIR OFFER!



TELETON SAQ203 TRANSISTOR STEREO AMPLIFIER

One of the most popular models from the fabulous Teleton range. Incorporates 16 transistors and diodes producing superb quality hi-fi. 10 watts per channel music power. Inputs for Gram (Magnetic and Crystal), Tuner and Auxiliary. Tape Record output. Controls: Volume, Balance, Bass, Treble. Stereo/Mono slide switch. Stereo headphone socket. Attractive oiled walnut cabinet with brushed aluminium front panel. List Price **£28.7.0**

OUR PRICE 22 GNS
P. & P. 12/6

TRANSFORMERS

AUTO WOUND TRANSFORMERS

All winding voltage ratings and tappings 0–115–200–220–240V, except MT113 0–115–210–240V

		Size	Weight	Price
MT113	20W	2⅛ × 1 11/16 × 1¾in	11oz	**12/6** (P. & P. 2/6)
MT64	75W	2⅞ × 2½ × 2⅜in	1lb 14oz	**21/9** (P. & P. 4/6)
MT4	150W	3½ × 2⅞ × 3in	3lb	**33/–** (P. & P. 6/–)
MT65	200W	3½ × 4½ × 4in	4lb	**39/6** (P. & P. 6/–)
MT66	300W	4 × 4 × 3¾in	6lb 7oz	**59/4** (P. & P. 9/–)
MT110	400W	4¾ × 4½ × 4in	11lb	**85/–** (P. & P. 10/–)
MT67	500W	5½ × 4 × 4½in	12lb 8oz	**89/–** (P. & P. 10/6)
MT83	750W	4½ × 5½ × 5½in	13lb 4oz	**95/7** (P. & P. 10/6)
MT84	1000W	4½ × 5½ × 5½in	16lb	**142/2** (Carr. extra)
MT93	1500W	5 5/16 × 5 7/8 × 6½in	28lb 9oz	**170/6** (Carr. extra)
MT94	1750W	5 5/16 × 6⅜ × 6½in	31lb	**195/–** (Carr. extra)
MT95	2000W	7 × 6½ × 8½in	40lb	**211/2** (Carr. extra)
MT73	3000W	6⅞ × 7⅛ × 8⅜in	45lb 8oz	**300/–** (Carr. extra)

LOW VOLTAGE 12V RANGE

Primary 200–250V; secondary 12V

MT111	0·5A	3 × 2½ × 1⅜in	12oz	**15/3** (P. & P. 2/6)
MT71	2A	2⅜ × 2½ × 2¼in	1lb	**19/–** (P. & P. 3/9)
MT69	4A	3½ × 2⅞ × 2⅜in	2lb 4oz	**28/–** (P. & P. 6/–)
MT70	6A	4 × 3 × 3⅜in	3lb 12oz	**39/–** (P. & P. 6/–)
MT72	10A	3½ × 4½ × 4in	6lb 3oz	**51/–** (P. & P. 9/–)
MT115	20A	4⅜ × 4½ × 4in	11lb 13oz	**95/–** (P. & P. 9/–)
MT187	30A	5½ × 4⅞ × 4¾in	16lb 12oz	**180/–** (P. & P. 13/6)

LOW VOLTAGE 24V RANGE

Primary 200/250V; secondary 24V

MT58	1A	2⅜ × 2⅜ × 2¼	1lb 7oz	**23/9** (P. & P. 4/6)
MT114	3A	2½ × 3 × 3in	3lb 6oz	**38/–** (P. & P. 6/–)
MT72	5A	4 × 3⅜ × 3⅜in	5lb 12oz	**53/10**(P. & P. 6/–)
MT17	8A	4⅜ × 3⅝ × 4in	7lb 8oz	**72/7** (P. & P. 9/–)
MT115	10A	4⅜ × 4½ × 4in	11lb 13oz	**95/–** (P. & P. 11/–)

LOW VOLTAGE 30V RANGE

Primary 200/250V; secondary tapped 12–15–20–24–30V

MT112	0·5A	3½ × 2 7/16 × 1 7/16in	1lb 4oz	**17/4** (P. & P. 3/9)
MT79	1A	2⅞ × 2½ × 2⅜in	2lb	**23/–** (P. & P. 6/–)
MT20	3A	4 × 3½ × 3⅜in	4lb 6oz	**46/2** (P. & P. 6/–)
MT51	5A	4⅜ × 3½ × 4in	6lb 8oz	**60/9** (P. & P. 9/–)
MT88	8A	5½ × 3⅜ × 4⅜in	9lb 6oz	**92/4** (P. & P. 11/–)
MT89	10A	5½ × 4 × 4⅜in	12lb 2oz	**103/6** (P. & P. 11/–)

LOW VOLTAGE 50V RANGE

Primary 200–250V; secondary tapped 19–25–33–40–50V

MT102	0·5A	2⅞ × 2⅜ × 2⅜in	1lb 11oz	**21/3** (P. & P. 6/–)
MT104	2A	4 × 3½ × 3⅜in	5lb	**45/8** (P. & P. 6/–)
MT106	4A	4⅜ × 4½ × 4	9lb 4oz	**77/–** (P. & P. 9/–)
MT118	8A	5½ × 5½ × 4⅜in	18lb 9oz	**132/–** (P. & P. 13/6)
MT119	10A	6½ × 4½ × 6½in	19lb 12oz	**165/–** (P. & P. 15/6)

LOW VOLTAGE 60V RANGE

Primary 200/250V; secondary tapped 24–30–40–48–60V

MT124	0·5A	3½ × 2⅜ × 2⅜in	2lb 4oz	**24/–** (P. & P. 6/–)
MT127	2A	4 × 3½ × 3⅜in	5lb 6oz	**52/10**(P. & P. 6/–)
MT123	4A	4½ × 3⅜ × 4½in	10lb 6oz	**99/–** (P. & P. 11/–)
MT122	10A	6½ × 5 × 6½in	23lb 2oz	**152/–** (Carr. extra)

MAINS H.T. RANGE

				Size	Price	P&P
MT1AT	250–0–250V	80MA	6·3V 3·5A 5/6·3V 1A	3½ × 3 × 3in	**33/–**	6/–
MT6AT	250–0–250V	100MA	6·3V 3·5A 5/6·3V 1A	4 × 3½ × 3½in	**38/3**	6/–
MT110	250–0–250V	120MA	6·3V 3·5A 5/6·3V 1A	4 × 4 × 3½in	**44/9**	6/–
MT11AT	300–0–300V	100MA	6·3V 3·5A 5/6·3V 1A	4 × 3½ × 3⅜in	**37/9**	6/–
MT12AT	300–0–300V	120MA	6·3V 4A 5/6·3V 1A	4 × 3⅜ × 3⅜in	**46/2**	9/–
MT33AT	300–0–300V	150	6·3V 4A 5/6·3V 1A	4 × 4 × 3⅜in	**59/4**	9/–
MT2AT	350–0–350V	80	6·3V 3·5A 5/6V 1A	4 × 3½ × 3⅜in	**38/6**	6/–
MT7	350–0–350V	100	6·3V 3·5A 5/6·3V 1A	4 × 3½ × 3⅜in	**42/4**	6/–
MT8	350–0–350V	120	6·3V 3·5A 5/6·3V 1A	4 × 3⅜ × 3⅜in	**50/–**	6/–

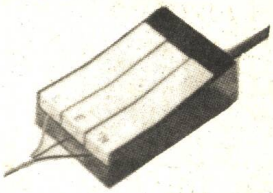
BATTERY CHARGER TYPES

Primary voltage 200–250V; secondary 6–12V (Rectifier not included)

MT77	1A	2¼ × 2¼ × 2⅜in	1lb 6oz	**15/–** (P. & P. 4/6)
MT45	1·5A	2⅜ × 2⅜ × 2⅜in	1lb 9oz	**21/9** (P. & P. 4/6)
MT46	2A	3½ × 2⅜ × 2⅜in	2lb 4oz	**25/4** (P. & P. 6/–)
MT47	3A	4 × 3 × 3⅜in	3lb 8oz	**28/4** (P. & P. 6/–)
MT5	4A	4 × 2⅜ × 3½in	3lb 11oz	**33/–** (P. & P. 6/–)
MT78	5A	4 × 3½ × 3⅜in	5lb 4oz	**42/–** (P. & P. 6/–)
MT86	6A	4 × 3½ × 3¾in	5lb 12oz	**48/–** (P. & P. 6/–)
MT48	7A	4 × 4 × 3⅜in	6lb	**56/7** (P. & P. 9/–)
MT146	8A	3½ × 4 × 4in	6lb 4oz	**75/–** (P. & P. 9/–)
MT49	9A	4⅜ × 3⅜ × 4in	7lb 8oz	**99/–** (P. & P. 9/–)
MT147	10A	4⅜ × 3½ × 4in	9lb 3oz	**105/–** (P. & P. 9/–)
MT50	12·5A	5½ × 4½ × 4⅜in	11lb 14oz	**125/–** (P. & P. 11/–)

Amperages are d.c. when used with nominal selenium bridge rectifiers
MAINS ISOLATING RANGE also available

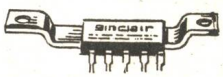
MAINS KEYNECTOR
SAVES TIME—SAFELY!



One mains "Keynector" instantly and safely connects electrical appliances to mains supply without the use of a plug. A number of appliances may be used simultaneously up to the full 13 amp rating of this device. A red light glows when "live". The "Keynector" is fused and has its own robust switch which is interlocked to prevent connections when "live".
Invaluable to handymen, servicemen, demonstrators, etc.
39/6 P. & P. 3/–.

VHF AIRCRAFT BAND CONVERTOR. When placed within 1in. of a MW band radio full coverage of VHF Aircraft Band 108-135Mc/s. can be obtained. All transistor, 9V battery operation. Fully tunable 18in. × 7 section telescopic aerial. Size 4 × 2¾ × 1½in. **79/6.** P. & P. 3/6.

SINCLAIR IC-10 INTEGRATED CIRC UIT

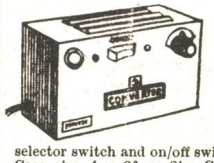


10 watt Amplifier. Size only 1 × 0·4 × 0·2in. A true hi-fi amplifier complete with manual giving details of a wide range of applications and instructions. Guaranteed 5 years. ONLY **59/6.** P. & P. 1/6.

SPECIAL TRANSFORMER FOR OPERATING SINCLAIR IC-10 from A.C. mains 230/250V. Output 13V at 0·5 amps. **12/6.** P. & P. 2/6.

SINCLAIR PROJECT 60
An attractive alternative for the enthusiast prepared to assemble these excellent modules to make a stereo assembly. Z.30 24W Power Amplifier **89/6** (2 required). Stereo Sixty Control/Pre amplifier **£9.19.6.** PZ.5 Power Supply Unit **£4.19.6.** Project 60 is supplied complete with instructions manual and templates for plinth mounting.

"HI-TEN" LOUDSPEAKER
British made full-range 10" unit handles up to 10W. Ceramic magnet. Frequency response, 40Hz–10kHz; imp.,15Ω; flux density, 10,000 lines. **49/6.** P. & P. 4/6.



Battery Eliminator, Enables transistor equipment to be operated from AC mains. 6/9/12V output selector switch and on/off switch. 100mA. Case size 4 × 2¾ × 2in. Complete with mains lead, connecting leads and instructions. **59/6.** P. & P. 3/6.

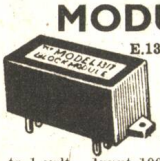
DE-LUXE STEREO HEADPHONES

With soft rubber earpieces. Impedance 8-16 ohms. Frequency response 23-13,000cps. With lead and stereo plug.
Only **59/6.** P. & P. 3/6.

LIND·AIR OPTRONICS LTD

See our vast range of Electronic Components and Accessories at our enlarged Component Centre 25 Tottenham Court Road

TRANSISTOR MODULES



E.1311. PHONO PRE-AMPLIFIER. Size 2 × 1 × ¾in. Built-in R.I.A.A. characteristics enabling low output magnetic pick-up cartridges to be amplified up to 1 volt. Input 100Kohm: Gain 28dB: Max. output 3V: Max. input 50mV. Distortion 0·15% (at 1V level). Power supply 9–12V. **29/6.** P. & P. 2/–.

E.1313. MICROPHONE PRE-AMPLIFIER. Enables a low output microphone to be used with an amplifier or radio. Input imp. 100Kohms: Gains 28dB: Max. output 3V: Max. input 50mV: Distortion 0·15% (at 1V level): Freq. response 10Hz–50KHz. Power supply 9–12V. **29/6.** P. & P. 2/–.

E.1318. DUAL LAMP FLASHER. A switch module for electronically alternating two miniature bulbs, 6V, 100–200mV. Ideal for models, toy boats and planes, displays, warning and security devices, communication signals, etc. Flasher time ½ sec: Power supply 6V DC: Current 150mA: Lamp 6V 150mA. **25/–.** P. & P. 2/–.

E.1315. ELECTRONIC ORGAN TONE OSCILLATOR. Used in conjunction with an organ keyboard, variable resistances and a 9 volt power supply, this module acts as the oscillator unit for an electronic organ. Tone Frequency: 200–1,000Hz: Output 80mW: Current 15mA. **25/–.** P. & P. 2/–.

E.1314. POWER AMPLIFIER. When used in conjunction with E.1311, E.1312 and E.1313 units this amplifier module produces about 300mW output for speaker connection (8–16 ohms), without necessity for an output transformer. Input imp. 1,000 ohms: Gain 20dB: Output 30mW: Distortion 3% (at 200mW output level). Freq. res. 50Hz–10KHz. Power supply 9V. Current 20mA at no signal, 80mA at max. output. **29/6.** P. & P. 2/–.

E.1317. MINIATURE MORSE TRANSMITTER. Will transmit to any adjacent AM Receiver, also makes a useful oscillator for trouble shooting. Audio tone 400c/s. Radio frequency range 400c/s to 30Mc/s. Power supply 9V DC. Current 35mA. **25/–.** P. & P. 2/–.

E.1312. TAPE PRE-AMPLIFIER. Incorporating N.A.R.T.B. curve characteristics this amplifies tape head signals up to 1 volt within the frequency range of 30Hz–15KHz. Input imp. 100 Kohm: Gain 25dB: Max. output 2V: Max. input 50mV: Distortion 0·15% (at 1V level): Power supply 9–12 volts. **29/6.** P. & P. 2/–.

E.1316. MORSE CODE OSCILLATOR. A transistorised morse code oscillator(buzzer) to be used in conjunction with an operating key. Suitable for direct connection to a loudspeaker. Tone freq. 400Hz: Power output 80mW: Power supply 3–9V: Current 45mA. **25/–.** P. & P. 2/–.

MINIATURE SOLDERING IRON
British made and designed for use with transistor circuitry but ideal for many other uses. A.C. 240V, 18W. Length 7⅛in, ⅛in slide on bit. Price **32/6.** P. & P. 2/–.

Visit our Brand New Hi-Fi Demonstration Room, Tape, Record Bar and Scientific Show of Microscopes, Binoculars, Telescopes and Watches at 18/19 Tottenham Court Road

FANTASTIC XMAS OFFER!

Lind Air Audio 'COMPACT' Hi·Fi Stereo System

IT'S OUT OF THIS WORLD!

NEVER BEFORE SUCH VALUE!

ONLY **39½ GNS** Carr. & Ins. 25/-

LIMITED PERIOD ONLY!

£5. 9. 6 DEPOSIT plus 25/- Carr. & Ins. and 9 monthly payments of £4. 9. 7. Total Credit Sale Price £45. 15. 9.

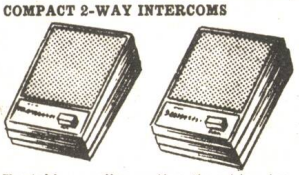
BIG SOUND AT LOW COST!

6 watts r.m.s. per channel. Controls: Bass, Treble, Volume, Balance, Function selector. Mono/Stereo switch. Tape record outlet. Inputs for Tape replay/Tuner. Headphone facility. Beautiful teak case with matched loudspeakers. Garrard Autochanger unit fitted Stereo Cartridge. Sizes: Plinth 16¼" × 14" × 3½" Speakers 12½" × 6" × 8"

EXCLUSIVE TO LIND-AIR

See and hear the Lind-Air Audio "Compact" now at London's Newest Hi Fi Store — All leading names in stock plus Expert Advice, Hi Fi and T.V. Demonstrations, Part Exchanges, Mail Order and Export Sales.

COMPACT 2-WAY INTERCOMS



For table or wall mounting. Smart two tone grey cases size 3½ × 1½ × 2½in. Complete with lead, staples and 9V battery. **55/–.** P. & P. 3/6.

HI-TONE RECORDING TAPE

BRITISH MADE TOP QUALITY

J1001	3"	Long Play PVC	225ft	**5/6**	P. & P. 1/2
J1002	3"	Triple Play Poly	600ft	**10/6**	P. & P. 1/2
J1003	5"	Long Play PVC	900ft	**10/–**	P. & P. 1/8
J1004	5"	Double Play Poly	1200ft	**15/–**	P. & P. 1/8
J1005	5½"	Long Play PVC	1200ft	**12/6**	P. & P. 2/–
J1006	5½"	Double Play Poly	1800ft	**22/6**	P. & P. 2/–
J1007	7"	Standard Play PVC	1200ft	**12/6**	P. & P. 2/6
J1008	7"	Long Play PVC	1800ft	**17/6**	P. & P. 2/6
J1009	7"	Double Play Poly	2400ft	**25/–**	P. & P. 2/6
J1010	7"	Triple Play Poly	3600ft	**50/–**	P. & P. 2/6

LAO

LIND·AIR OPTRONICS LTD

18/19, 25 & 53 TOTTENHAM CT. ROAD, LONDON W.1.

Telephone: 01-580 2255/4532/7679

Shops open 9-6 pm. Monday to Saturday. Thursday until 7 pm.

ALL MAIL ORDERS To Dept. PE 170 54a Tottenham Court Road, London, W.1

NOW! A FAST *EASY* WAY TO LEARN BASIC RADIO AND ELECTRONICS

Build as you learn with the exciting new TECHNATRON Outfit! No mathematics. No soldering—but you learn the *practical* way.

Now you can learn basic Radio and Electronics at home—the *fast*, modern way. You can give yourself the essential technical 'know-how' sooner than you would have thought possible—read circuits, assemble standard components, experiment, build . . . and enjoy every moment of it. B.I.E.T's Simplified Study Method and the remarkable new TECHNATRON Self-Build Outfit take the mystery out of the subject—make learning *easy and interesting*.

Even if you don't know the first thing about Radio now, you'll build your own Radio set within a month or so!

. . . and what's more, YOU'LL UNDERSTAND EXACTLY WHAT YOU ARE DOING. The Technatron Outfit contains everything you need, from tools to transistors . . . even a versatile Multimeter which we teach you how to use. You need only a little of your spare time, the cost is surprisingly low and the fee may be paid by convenient monthly instalments. You can use the equipment again and again—and it remains your own property.

You LEARN—but it's as fascinating as a hobby.

Among many other interesting experiments, the Radio set you build—and it's a good one—is really a bonus; this is first and last a *teaching* Course. But the training is as rewarding and interesting as any hobby. It could be the springboard for a career in Radio and Electronics or provide a great new, spare-time interest.

A 14-year-old could understand and benefit from this Course—but it teaches the real thing. Bite-size lessons—wonderfully clear and easy to understand, practical projects from a burglar-alarm to a sophisticated Radio set . . . here's your chance to master basic Radio and Electronics, even if you think you're a 'non-technical' type. And, if you want to carry on to more advanced work, B.I.E.T. has a fine range of Courses up to A.M.I.E.R.E. and City and Guilds standards.

Send now for free 164-page book. Like to know more about this intriguing new way to learn Radio and Electronics? Fill in the coupon and post it today. We'll send you full details and a 164-page book—'ENGINEERING OPPORTUNITIES'—Free and without any obligation.

BRITISH INSTITUTE OF ENGINEERING TECHNOLOGY
Dept. 371B, Aldermaston Court,
Aldermaston, Berkshire.

POST THIS COUPON NOW!

To: B.I.E.T., Dept. 371B, ALDERMASTON COURT, ALDERMASTON, BERKS.

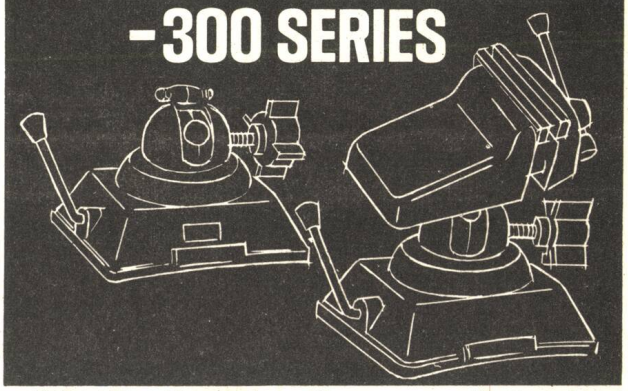
I would like to know more about your Practical Radio & Electronics Course. Please send me full details and FREE 164-page book.

name.....

address.....

.....age.....

COLBERT WORK POSITIONERS -300 SERIES



Colbert Pana-Vise **work positioners** are specifically designed to quickly and easily achieve the most **convenient, comfortable** and **time-saving** work position.

Available with vacuum clamp or screw-on base.

They can be **rotated, tipped, tilted, angled, elevated, lowered.**

The required work position is firmly secured with a patented **one-knob control,** a unique feature of **Colbert Positioners.**

A series of special holders is available for various types of work.

Full details available on request.

Distributors:

SPECIAL PRODUCTS DISTRIBUTORS LTD.
81 Piccadilly, London, W.1. Tel. 01-629 9556 Cables: *Speciprod London*
(Made in U.S.A.)

NEW COMPONENTS
BY RETURN OF POST

RESISTORS
High stability carbon film. Very low noise. 0·5 watt 5% 4·7 ohms to 2·2MΩ **2d each.** 0·5 watt 10% 4·7 ohms to 10MΩ **2d each.**

DEVELOPMENT PACK
0·5 watt 5% resistors **50/-.** 325 resistors 5 off each value, 4·7 ohms to 1MΩ (E12 series).

4 WATT WIRE WOUND RESISTORS 1/6 each.
10% 1·0, 1·8, 2·7, 3·3, 3·9, 4·7, 5·6, 6·0, 6·8, 8·2 ohms.
5% 10, 15, 20, 25, 50, 100 ohms.

MULLARD POLYESTER CAPACITORS ±10%
400V: 0·001μF, 0·0015μF, 0·0022μF, 0·0033μF, 0·0047μF, 0·0068μF, 0·01μF, 0·015μF, 0·022μF, 0·033μF, **6d.** 0·047μF, 0·068μF, 0·1μF, **8d.**
160V: 0·01μF, 0·015μF, 0·022μF, 0·033μF, 0·047μF, 0·068μF, **6d.** 0·1μF, 0·15μF 0·22μF, **8d.** 0·33μF, **1/-.** 0·47μF, **1/4.** 0·68μF, **2/-.** 1·0μF, **2/6.**
250V: P.C. mounting miniature ±20%: 0·01μF, 0·015μF, 0·022μF, 0·033μF, 0·047μF, 0·068μF, **6d.** 0·1μF, 0·15μF, 0·22μF, **7d.**

MINIATURE ELECTROLYTIC CAPACITORS (−10% +50%)

50μF	6·4V	10μF	10V	125μF	10V	40μF	16V	8μF	40V
100μF	6·4V	16μF	10V	200μF	10V	6·4μF	25V	16μF	40V
200μF	6·4V	20μF	10V	10μF	15V	10μF	25V	50μF	40V
320μF	6·4V	25μF	10V	16μF	15V	16μF	25V	10μF	64V
6·4μF	10V	64μF	10V	25μF	15V	25μF	25V	20μF	64V

1/- each, 10/6 doz.
250μF 16V 1/6. 100μF 40V 1/3.

CERAMIC DISC CAPACITORS
100pF, 270pF, 470pF, 680pF, **5d each.**
0·02μF, 800V, **8d each.**

SKELETON PRE-SET POTENTIOMETERS
Miniature linear 100, 250, 500 ohms and decades to 1MΩ.
0·3 watt ±20% ≤ 250 kΩ ±30% > 250kΩ.
Horizontal or vertical P.C. mounting (0·1 matrix) **1/- each.**

DIODES—OA85, OA91, 1/6 each.

SILICON RECTIFIERS
BY236 800V 0·8 amp **3/- each.**
BY237 1250V 0·8 amp **3/6 each.**

VEROBOARD
0·1 matrix: 2½ × 3¾ **3/6,** 3¾ × 3¾ **4/3,** 5 × 2½ **4/3,** 5 × 3¾ **5/3.**
0·15 matrix: 2½ × 3¾ **3/3,** 3¾ × 3¾ **3/9,** 5 × 2½ **3/9,** 5 × 3¾ **5/3.**
Spot Face Cutter **7/6.** Terminal Pins 36 for **3/-.**

C.W.O. please. 1/- post and packing on orders under £1.

Export Enquiries welcome

YATES ELECTRONICS (FLITWICK) LTD.
29 LYALL CLOSE, FLITWICK, BEDS.

COMPLETE STEREO SYSTEM

FOR ONLY 39 GNS

CARRIAGE 35/-

The Premier Stereo System consists of an all transistor stereo amplifier, Garrard Model 2025 auto/manual record player unit fitted stereo/mono cartridge and mounted in teak finish plinth with perspex cover and two matching teak finish loudspeaker systems. Absolutely complete and supplied ready to plug in and play. The 10 transistor Amplifier has an output of 5 watts per channel with inputs for pick-up, tape and tuner also tape output socket. Controls: Bass, Treble, Volume, Balance, Selector. Power on/off, stereo/mono switch. Brushed aluminium front panel. Black metal case with teakwood ends: Size 12" × 5½" × 3½" high (Amplifier available separately if required **£14.19.6.** Carr. 7/6).

SPECIAL STEREO CARTRIDGES

SHURE

M3D	List £8.10.6.	**Premier Price £6.19.6**
M44-5	List £14.9.1.	**Premier Price £10.10.0**
M44C	List £12.19.5.	**Premier Price £9. 9.0**
M44E	List £17.8.4.	**Premier Price £13.19.6**
M55E	List £20.15.1.	**Premier Price £15.15.0**
M75-6	List £17.8.4.	**Premier Price £13.19.6**
M75E	List £25.18.10.	**Premier Price £21.0.0**

AUDIO-TECHNICA

AT7S	Stereo	List £22.0.0	**Our Price £15.0.0**
AT7X	Elliptical	List £25.0.0	**Our Price £18.0.0**

Post and Packing 1/6 each

"NOVA" TRANSISTOR STEREO AMPLIFIER

A superb stereo amplifier offering every facility for the hi-fi enthusiast. Output 10 watts per channel. Frequency response 40–20,000Hz ± 3dB. Inputs for Radio, P.U. Ceramic, P.U. Magnetic Tape. Separate bass and treble controls, Volume and Balance Controls. Mono/Stereo Switch. Also features headphone socket and tape output. Teak case with attractive illuminated front panel. Size 14½ × 9½ × 3½in., a.c. 200/250V.

WONDERFUL VALUE AT ONLY 25 gns. Carr. 10/-.

'NOVA' 5 WATTS PER CHANNEL STEREO AMPLIFIER. Specification as above. **£18.18.0.** Carr. 10/-.

PICK-UP CARTRIDGES

AT MONEY SAVING PRICES!

GOLDRING G800 (Stereo)	**£8.19.6**
SONOTONE 9TAHC/D (Stereo)	**£2.15.0**
ACOS GP91/1SC (Mono compatible) .	**£1.13.5**
ACOS GP93-1 (Stereo)	**£2. 8.7**
ACOS GP94 (Stereo)	**£2.14.8**
B S R X3M (Mono compatible)	**£1.16.5**
B S R X3H (Mono compatible)	**£1.16.5**
RONETTE 105 (Stereo)	**£1.15.0**
RONETTE 106 (Stereo)	**£1.15.0**

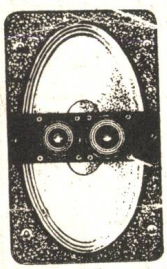
All complete with mounting brackets and instructions. Post and Packing 1/6 each.

WIDE RANGE OF HI-FI STEREO EQUIPMENT ON DEMONSTRATION

All leading makes available including Rogers, Armstrong, Dulci, Wharfedale, Goodmans, Goldring, Shure, etc. etc.

SAVE NEARLY £5!

Premier Stereo System with "Nova" 10 watt Stereo Amplifier as above. **45 Gns.** Carr. 35/-.



E.M.I. 13 × 8in HI-FI SPEAKERS

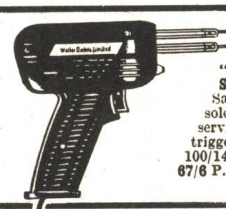
Fitted two 2½in tweeters and crossover network. Impedance 3 & 15 ohms. Handling capacity 10W. Brand new. **99/6.** P. & P. 7/6. Also available without tweeters. **49/6.** P. & P. 7/6.

TEAK FINISHED CABINET Size 17½ × 10 × 7½in. Ideal for above speakers. **£5.10.0.** P. & P. 7/6.

VERITAS V–149 MIXER

Battery operated 4-channel audio mixer providing four separate inputs. Size 6 × 3 × 2in. suitable for crystal microphone, low impedance microphone with transformer, radio, tape, etc. Max. input 1·5V, max. output 2·5V, gain 6dB. Standard jack plug socket inputs, phonoplugs output. Attractive teak wood grain finish case.

Mono Model 59/6 **Stereo Model 69/6** P. & P. 2/6.



"WELLER EXPERT" SOLDER GUN. Saves time and simplifies soldering in the home and service dept. Two position trigger gives instant dual heat 100/140 watt. 240 volt A.C. **67/6** P. & P. 2/-.

POCKET SIZE MULTI TESTER With wide-angle, jewelled meter movement, ceramic long-life, low-loss switching, tough impact resisting case. Sensitivity 20,000 ohms/volt d.c. 10,000 ohms/volt a.c. **19 Ranges:** 0-5-25-50-250-500-2,500 volts d.c. 0-10-50-100-500-1,000 volts a.c. 0-50μA-2·5mA-250mA d.c. 0-6,000 ohms-6 megohms, 10μ μF-0·001 mF-1 mF. —20 to +22dB. Complete battery, test lead and instructions. **£4.19.6** P. & P. 3/6.

HI-FI STEREO HEADPHONES

Designed to the highest possible standard. Fitted 2½in speaker units with soft padded ear muffs. Adjustable headband. 8 ohm impedance. Complete with 6ft lead and stereo jack plug. **59/6** P. & P. 5/-.

MONO HEADPHONES 2,000 ohm **14/6** P. & P. 2/6.
STEREO STETHOSCOPE SET Low imp. **25/-** P. & P. 2/-.
MONO STETHOSCOPE SET Low imp. **10/6** P. & P. 2/-.

'VERITAS' V–313 TAPE HEAD DEFLUXER

A must for all tape users! Tape heads become permanently magnetized with constant use; this leads to background noise that prevents perfect recordings. Simply applied to recording head the V313 leaves head free of magnetism. Cleans any tape head in seconds. **34/6** P. & P. 1/6

SPECIAL BARGAIN OFFER!

B.S.R. MA75 RECORD PLAYER UNIT, 4 speeds. Automatic or Manual operation. Low mass arm with cue and pause lever, bias compensator, stylus pressure adjuster, etc. Complete with Stereo/Mono Cartridge. Original Price £17.17.8 OUR PRICE **12 gns.** Carr. 10/6

TWO STATION TRANSISTOR INTERCOMS.

Complete with battery and 50ft connecting wire. Compact size, two way call system. Ideal for home, office, factory, etc. **65/-** P. & P. 4/-.

FOUR STATION INTERCOM. Master unit and 3 slaves. Ideal for office and home. Complete with battery and connecting wire **£7.19.6.** P. & P. 5/6.

"VERITONE" RECORDING TAPE

SPECIALLY MANUFACTURED IN U.S.A. FROM EXTRA STRONG PRE-STRETCHED MATERIAL, THE QUALITY IS UNEQUALLED.

TENSILISED to ensure the most permanent base. Highly resistant to breakage, moisture, heat, cold or humidity. High polished splice free finish. Smooth output throughout the entire audio range. Double wrapped—attractively boxed.

LP3	3"	250'	P.V.C.	5/6	**LP6**	5½" 1200'	P.V.C.	12/6
TT3	3"	450'	POLYESTER	7/6	**DT6**	5½" 1800'	POLYESTER	22/6
DT3	3½"	600'	POLYESTER	11/6	**TT6**	5½" 2400'	POLYESTER	37/6
SP5	5"	600'	P.V.C.	8/6	**SP7**	7" 1200'	P.V.C.	12/6
LP5	5"	900'	P.V.C.	10/-	**DT7**	7" 2400'	POLYESTER	25/-
DT5	5"	1200'	POLYESTER	15/-	**TT7**	7" 3600'	POLYESTER	50/-

TAPE SPOOLS 3" 1/-, 5", 5½", 7" 1/9. **TAPE CASES** 5", 7" 2/6.
Post and Packing 3" 1/-, 5", 5½" 1/6, 7" 2/-. (3 reels and over Post Free.)

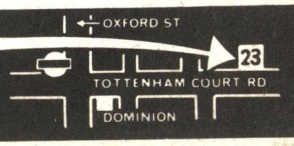
"PREMIER" TAPE CASSETTES

C60 (60 min.) **7/6**
THREE FOR 21/-
C90 (90 min.) **12/6**
THREE FOR 36/-
C120 (120 min.) **17/6**
THREE FOR 51/-
P. & P. 1/-.

CASSETTE HEAD CLEANER
Removes unwanted deposits from delicate tape heads. Fits all cassette recorders. **11/6** P. & P. 1/-.

PREMIER RADIO

23, TOTTENHAM COURT ROAD, LONDON, W.1 Tel: 01-636 3451



Give us a ring on Christmas day!

. . . or any day you please (Sundays included)—any time of day or night. Your message will be received loud and clear. Even if we are not there "live" at the other end of the line, our telephone recording machine will take your message for us to deal with as soon as we are back on the job. If your message is a fat order we'll be delighted. If it's just a teeny weeny order we'll still be delighted.

This "order-by-phone" facility is just one of the many advantages offered by our new CREDIT ACCOUNT SERVICE. Here are a few more advantages—

Order forms and prepaid envelopes are provided, so if you want to order by post, you don't even have to find a stamp. To settle your account you need only *one* cheque, postal order or money order per month. Normally on credit accounts there is a minimum invoice of 30/-, but *we* stipulate *no* minimum.

Of course, this Credit Account Service is available only if you are already using our catalogue for ordering components, but after you have been in the service for 12 months we regularly send you an up-to-date catalogue **FREE** of charge.

Like to know more about this trouble-saving, money-saving service? Then drop us a line or give us a ring, 01-648 8422.

You should certainly have an up-to-date copy of the Home Radio Catalogue even if you do not intend to use our Credit Account Service. It's a *must* for every Radio and Electronics enthusiast. It has 350 pages and lists 8,000 components, over 1,500 of them illustrated. Moreover, it contains 6 vouchers, each worth 1/- when used as indicated. Give *yourself* a Christmas present this year. Post the coupon with 12/- (8/6 plus 3/6 post and packing) and we'll send your catalogue by return of post.

Please write your Name and Address in block capitals

NAME .....

ADDRESS .....

.....

.....

Home Radio (Components) Ltd., Dept. PE,
234-240 London Road, Mitcham, CR4 3HD.

A Merry Christmas to all our Readers!

VOL. 6 No. 1 January 1970

PRACTICAL ELECTRONICS

Editor F. E. BENNETT Assistant Editor M. A. COLWELL Editorial Assistants D. BARRINGTON G. GODBOLD M. KENWARD
Art Editor J. D. POUNTNEY Technical Illustrators J. A. HADLEY P. A. LOATES
Advertisement Manager D. TILLEARD

DISPELLING THE MYSTIQUE

CURRENT affairs commentators make free with colourful phrases concerning "this age of electronics." These evocative declamations are apt, and correct. Yet there are signs that some of the original lustre has worn off the image this well exposed branch of contemporary technology conjures up in the public's mind. While without a doubt a mystical aura still surrounds the subject, following upon many demonstrations of its efficiency and versatility in providing all manner of services in everyday life, electronics seems to have become accepted as the modern marvel—with an answer to most of the problems encountered in this increasingly complicated and highly organised world. News of further striking technical advances tends to be received passively, as though the public has been conditioned to expect these as perfectly natural happenings—though the manner in which they are achieved is not understood. The wonderment of the early days has given way to quiet respect.

This general deference to a rather mysterious power contrasts with the easy familiarity which has been developed by technically inclined individuals towards electronics. To the uninitiated it may seem hard to believe, but without question electronics is an ideal and convenient subject for private study and experimentation. It is certainly *not* a subject to shrink from in fear and bewilderment—despite its formidable attributes. The swing over to solid state and the ensuing miniaturisation are, of course, factors of immense practical advantage and have been quickly recognised by enthusiasts from all walks of life. The component supply situation, apart from occasional difficulties with particular "special" items, is good and many of the latest circuit devices soon emerge onto the retail market.

Thus while electronics has been making phenomenal progress and extending its influence into all areas of modern life, the know-how has not remained a closed book to all except the professionals. It is open for any private person to explore and so experience at first hand much of the evolution in components and circuit design which is a continuing process in the industry.

From active home work develops a new and fuller appreciation of the potentialities of electronics. The informed amateur is not likely to be bamboozled by mere words and phrases. He knows the universality of electronics and sees the future even more dominated by this technology. But with knowledge based upon personal involvement he can also cut the "monster" down to size; to flip-flops, gates, linear amplifiers, phase inverters, and all—the very circuit "bricks" he makes and uses himself.

F.E.B.

THIS MONTH

CONSTRUCTIONAL PROJECTS

METAL DETECTOR 24
HI FI STEREO AMPLIFIER 35
P.E. COMMUNICATIONS RECEIVER—4 46
P.E. ORGAN—9 52
EDUCATED EMMA 62

SPECIAL SERIES

DEMONSTRATION SWITCHING CIRCUITS—2 42

GENERAL FEATURES

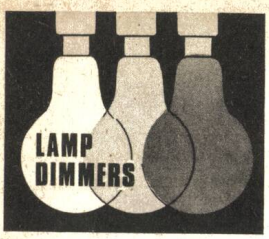
THYRISTORS AND THE EXPERIMENTER 18

NEWS AND COMMENT

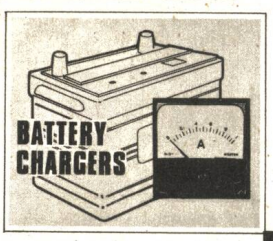
EDITORIAL 17
SPACEWATCH 32
NEWS BRIEFS 50, 58
POINTS ARISING 50
BOOK REVIEWS 51
REPORT FROM AMERICA 61
MARKET PLACE 77
READOUT 78

Our February issue will be published on Thursday, January 15

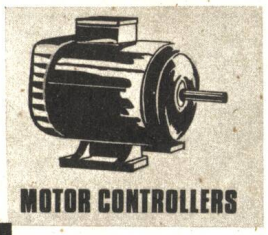
© IPC Magazines Limited 1970. Copyright in all drawings, photographs and articles published in PRACTICAL ELECTRONICS is fully protected, and reproduction or imitations in whole or part are expressly forbidden. All reasonable precautions are taken by PRACTICAL ELECTRONICS to ensure that the advice and data given to readers are reliable. We cannot, however, guarantee it, and we cannot accept legal responsibility for it. Prices quoted are those current as we go to press. Subscription Rates including postage for one year, to any part of the world, 42s. All correspondence intended for the Editor should be addressed to Tower House, Southampton St., London, W.C.2. Phone: 01-836 4363. Address correspondence regarding advertisements to Advertising Manager, Fleetway House, Farringdon St., London, E.C.4. Phone 01-236 8080

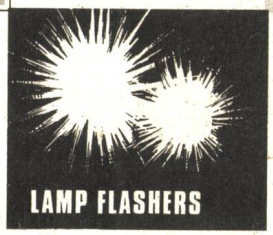


THYRISTORS AND THE EXPERIMENTER



By
J.N.WATT





Of all the semiconductor devices which have become generally available to the home experimenter, surely the silicon controlled rectifier (s.c.r.), or thyristor, is one of the most useful, and, at the same time, least appreciated. Transistors of course have wide application, but what follows will show that thyristors are capable of a multitude of uses, often at currents and voltages—and hence power levels—well out of reach of transistor circuitry.

FIRST a mention of how one of the names for these devices, the *thyristor,* is derived. It comes from THYRatron transISTOR, and those readers who are familiar with the thyratron or gas filled valve will recognise much of the properties of the thyristor. A proper understanding of these properties is vital to a full appreciation of the circuits which follow, and it is worthwhile to set down here three basic characteristics.

BASIC CHARACTERISTICS

1. A thyristor will conduct in only one direction, and when doing so behaves very much as an ordinary silicon diode; that is, it exhibits a low resistance and hence dissipates little power.

2. However, in order to conduct it is not sufficient that the anode be made positive. For conduction to take place, a third electrode, the "gate" (corresponding to the grid of a thyratron) must be made slightly positive with respect to the cathode. The power needed to do this is only a small fraction, a *very* small fraction, of the power it is possible to control, and it is this property that can be exploited so well in thyristor circuitry.

3. Even with this positive voltage removed from the gate, the thyristor continues to pass current (as mentioned in 1 above) provided the value of this current does not fall below a certain, small, value, known as the holding current. A typical holding current for a 3A thyristor is 30mA. Should this fall in current take place, the thyristor will "block", the current will fall to zero and the re-application of a positive gate voltage will be required for conduction to start again.

PHYSICAL DETAILS

Thyristors are available with voltage ratings up to 1,200 volts and current ratings up to 250A—although it is not suggested that home experimenters should use such high power types! Devices of 400V rating will be suitable for mains use and lower voltage ratings such as 50V to 100V are satisfactory for battery driven equipment.

The physical construction of a thyristor varies of course with the voltage and current it is able to handle, and the more usual outlines and connections are as shown in Fig. 1. Also depicted is the circuit symbol for this device.

Construction (a) is used for lower current devices, say up to 2A, while higher ratings usually employ one of the other forms. Most popular is perhaps stud

mounting (b), since it requires only a single hole to be made; (d) is of more recent origin, with thyristors of plastic encapsulation now being made.

TWO MAIN GROUPS OF CIRCUITS

The three important properties mentioned earlier lead to an abundance of thyristor circuits, and it will be convenient to classify these circuits into two broad groups:

1. Circuits using d.c. supplies, such as a solid state relay, flashers, and battery chargers.
2. Circuits using a.c. supplies, such as lamp dimmers, motor speed controllers (already described in PRACTICAL ELECTRONICS), temperature control, and mains lamp flashers.

In all the circuits which follow component values given are not necessarily optimum, but have been selected to show the principles involved.

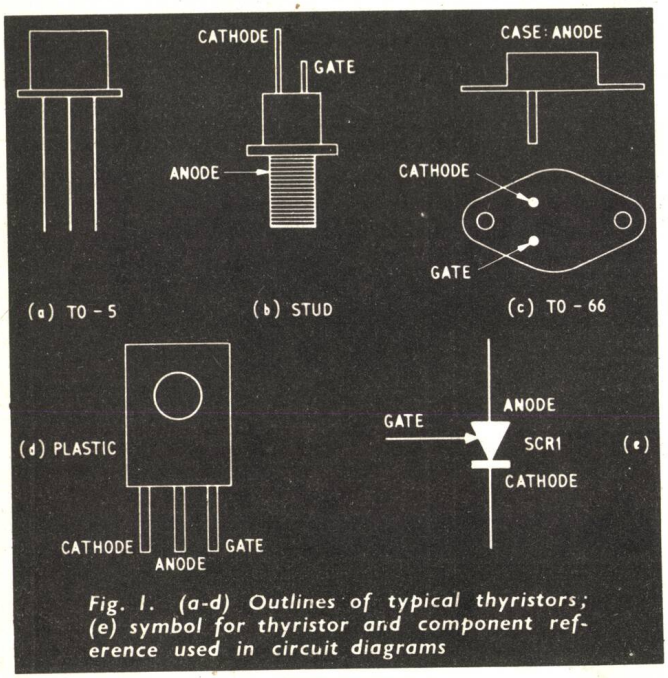


Fig. 1. (a-d) Outlines of typical thyristors; (e) symbol for thyristor and component reference used in circuit diagrams

Thyristors have large spreads in their detailed characteristics, notably gate current required for turn on, which varies with temperature, and it may be found that slight alterations in some resistor values will be required.

However, unmarked devices, advertised in PRACTICAL ELECTRONICS, as well as manufacturers' type numbered products should all work well and experimenters can proceed with confidence. Thyristors are tolerant devices (provided ratings are not exceeded of course) and will be found to be easy to use in the circuits to be given.

A SIMPLE THYRISTOR CIRCUIT

The simplest circuit which finds practical use is shown in Fig. 2. The load can be a lamp or a relay; nothing sophisticated is needed for the positive pulse shown at the gate, indeed a resistor momentarily connected to the positive supply will switch on the thyristor.

Uses for this simplest of all circuits are remote operation of a lamp where switch-on at a distance is needed and voltage drop in the lamp cable could be troublesome, for only the small gate current will be required to flow to the remote switching point, and then

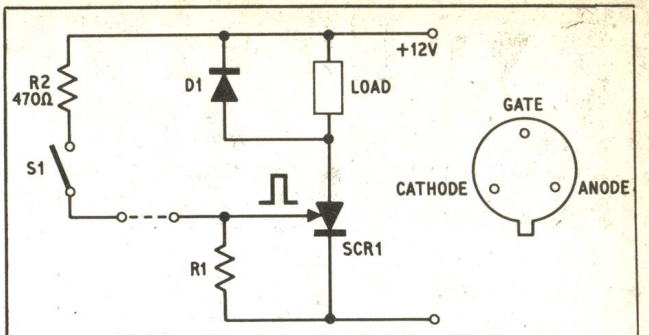


Fig. 2. Simple load switching circuit

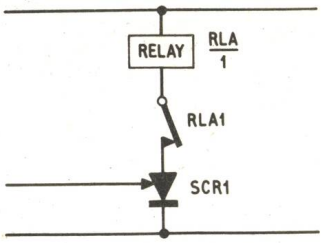
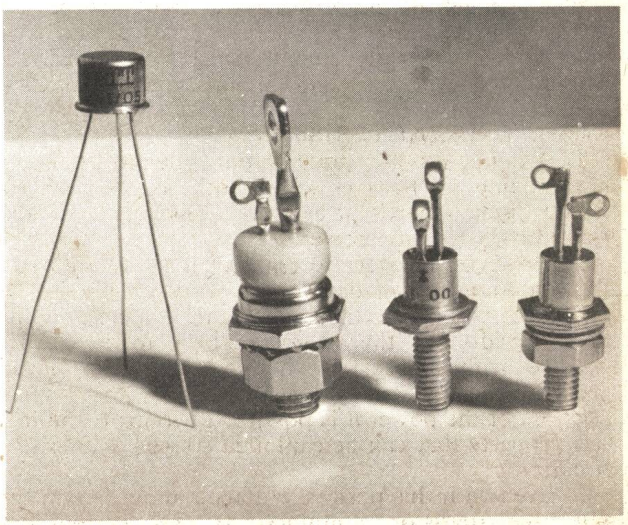


Fig. 3. Use of a relay in lieu of a buzzer

only for a few milliseconds or less. The resistor R1, which should be about 1 kilohm, is required to ensure that the thyristor does not switch on spuriously, especially at higher temperatures.

Typical connections for a 100V thyristor are as shown, and almost any device of that rating capable of carrying 1A will work well, controlling, say, a 12 watt lamp. The diode D1 across the load removes any high voltage transients present when the current changes, which could damage the thyristor.

The load in Fig. 2 could be a buzzer or bell, and the self-interrupted nature of the current through it will ensure that when the gate circuit is opened, buzzer operation ceases. Should operation of a buzzer be required from a distance, this will enable a lighter gauge cable to be used to the operating push or switch, so recouping the cost of the thyristor. If desired, a relay with a normally closed contact wired as shown in Fig. 3 can be substituted for the buzzer.



SWITCHING OFF ARRANGEMENT

To switch off the current in the load of Fig. 2 it is easiest to break the supply; however a useful alternative is given in Fig. 4. With the thyristor conducting and hence with its anode at only a volt or so positive, C1 charges to almost 12 volts. Closure of the switch earths the right-hand side of C1, and since the charge on C1 is unable to change instantaneously, the left-hand side of C1, and hence the thyristor anode, will be at about −11V; this switches off the thyristor.

A drawback of this circuit is that if the switch is left closed, C1 charges through the load with the opposite polarity, and hence an ordinary electrolytic cannot be used.

It is possible to use a second thyristor in place of the switch, and since it is called upon to pass only the current through R3 it can be a low current rating device, which will be both more sensitive and cheaper.

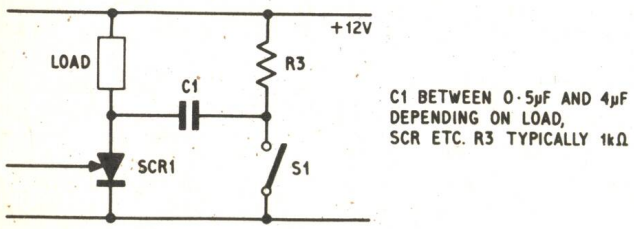


Fig. 4. A method of switching off a thyristor

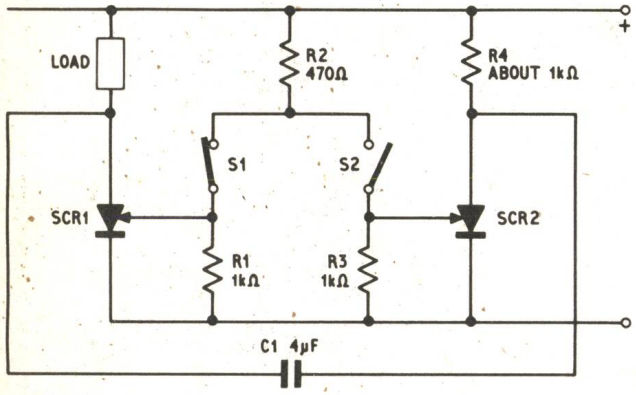


Fig. 5. A d.c. controller developed from the basic circuit of Fig. 2

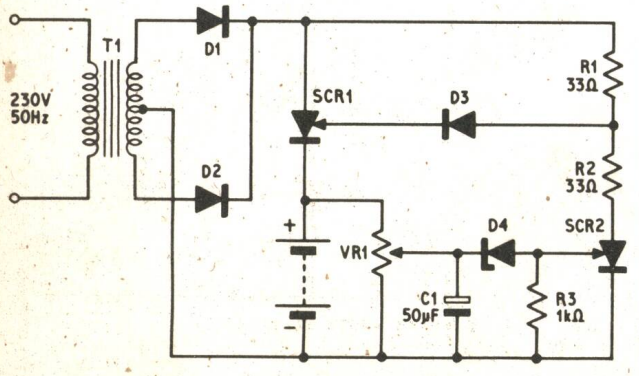


Fig. 6. Controlled battery charging

EFFICIENT MOTOR CONTROLLER

An application of this circuit which should be of interest to model control enthusiasts is given in Fig. 5.

The load is energised when S1 is closed and S2 opened, and de-energised when S1 is opened and S2 closed. If S1 and S2 are the contacts of a pair of reed relays in the collectors of a multivibrator running at, say, 200Hz, variation of the mark-space ratio will alter the mean current in the load, which could be a drive motor.

This is a very efficient controller for d.c. to run motors, lamps, etc.—there is little power wasted in dropper resistors and the use of lightly loaded reed relays ensures long life and reliability.

The control of high current d.c. supplies is thus possible where the use of a series transistor would be difficult or expensive. This circuit forms the basis of control used in fork lift trucks and in experimental electric cars.

BATTERY CHARGERS

The very name "silicon controlled rectifiers" would lead one to believe that such units as battery chargers could have their charging rate controlled, and such is the case. It is possible to arrange for the charger to be cut-off when a pre-set battery voltage is reached, so that over-charging is impossible. A typical circuit is given in Fig. 6, and is admittedly somewhat complex in appearance, although straightforward in operation.

With a discharged battery, each half-cycle of mains input delivers current to the battery via SCR1 since it is turned on at its gate via R1 and the diode. As charging proceeds, battery voltage rises until the potential at VR1 slider exceeds the Zener voltage of D4, so causing it to conduct. Its anode therefore goes positive, so switching on SCR2 (this latter thyristor is not required to carry charging current and can thus have a low current rating, which implies that its gate triggering will be more sensitive—an advantage here as it was in connection with the circuit of Fig. 4.)

Further charging, giving rising battery voltage, means that the point in the half-cycle at which SCR2 conducts will become earlier and earlier, until eventually it takes place *before* SCR1 has had a chance to turn on. With SCR2 conducting, the junction R1/R2 is only just above earth, so that SCR1 is unable to switch on; thus charging ceases. The battery voltage at which this occurs is set by VR1.

Should battery voltage fall, charging will re-start, so making the circuit suitable for those uses where a battery is called upon to provide high rate, intermittent, short discharges and is left across the charger continuously. Use of the circuit of Fig. 6 will permit a smaller battery to be employed (overcharging would be more harmful to a small battery).

CONTROL OF A.C. SUPPLIES

All the circuits mentioned up to this point have controlled d.c. supplies, but it is in the field of a.c. control that thyristors are perhaps most attractive.

There are two different methods for operating a thyristor in a.c. circuits, these are known as "phase shift" and "burst fire" operation.

In phase shift the thyristor conducts for a certain period during every positive half cycle. The point on the positive-going waveform at which conduction commences is the controllable factor, and the amount of power passed through the load is varied accordingly.

In burst-fire control the thyristor switching cycle is longer, and trains of "whole" pulses are passed. The

mark-space ratio determines the length of these trains of pulses, and so the amount of power consumed in the load.

Phase shift is the easier method so far as the circuitry is concerned; it does, however, have certain disadvantages, as will be pointed out in due course. Its use is therefore best confined to low power functions, such as light control.

LAMP DIMMING

Starting with domestic lamp dimming; perhaps the only advantage of the gaslight of former decades over present electric lamps was the ease with which the intensity could be readily adjusted! Now, the availability of cheap thyristors has changed the picture dramatically.

If only slight dimming of, say, a 100 watt lamp to the equivalent of a 60 watt lamp is required, then the circuit could hardly be simpler—see Fig. 7.

HALF WAVE CONTROL

When the line is more negative than the neutral, diode D1 conducts and supplies current to the lamp. On the other half-cycle, with line more positive than neutral, the thyristor conducts, starting at a time depending on the setting of VR1. This resistor and capacitor C1 give a retarded phase shift to the gate voltage, so that as VR1 increases, the shift increases, so delaying turn on of SCR1 in alternate half-cycles. The diode D2 prevents the thyristor gate from going more negative than the cathode during the half-cycles when D1 conducts. As the waveforms in Fig. 8 show, delayed turn on of the thyristor gives reduced power in the load.

The circuit is not critical of the type of thyristors and diodes used. Unmarked devices of 400V rating as well as Mullard BTY 79-400R have worked well; D1 should be rated at 400V p.i.v. and be capable of carrying 0·5A for lamps up to 200 watts, though D2 need only be of 100V working and of lower current capacity, say 100mA.

With the circuit shown a useful reduction in light output is obtained with VR1 at maximum resistance, but of course no more than a 90 degree phase shift can be provided by a simple RC network. If D1 is switched out, control down to lower lamp brilliance is possible, but since only alternate half-cycles of the 50Hz mains are thereby being used, there is an annoying flicker from the lamp.

FULL WAVE CONTROL

With slightly more complexity and expense, full smooth control from full brilliance down to zero output is possible and two circuits for this are given. Each shows a different approach to the problem, which is not perhaps surprising since one circuit is that due to Messrs. SGS UK Ltd. while the other originated with S.T.C. Ltd.

Basically, what is required is a means of controlling both half-cycles of the 50Hz mains together, in one

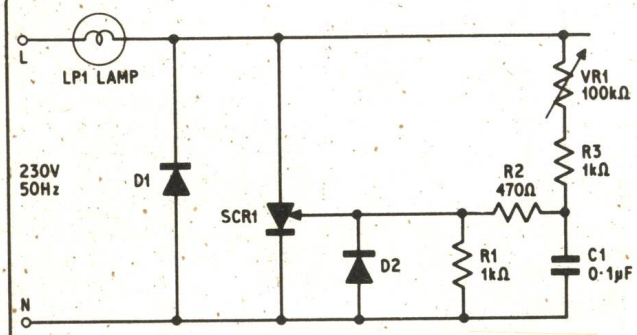


Fig. 7. Simple lamp dimmer—half wave control

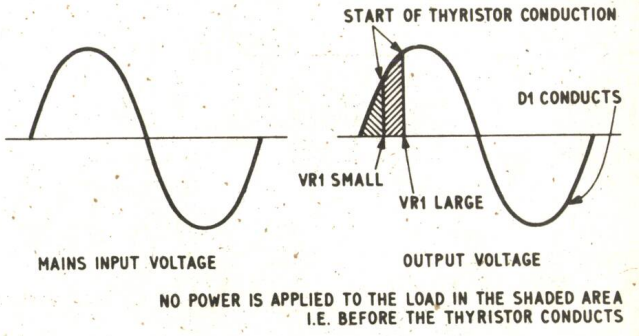


Fig. 8. These waveforms show how the thyristor controls the power in the load with the phase-shift method of operation

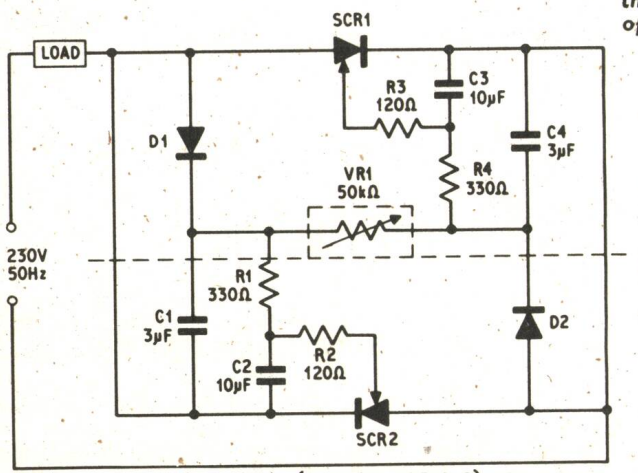


Fig. 9. Lamp dimmer—full wave control (SGS UK Ltd.)

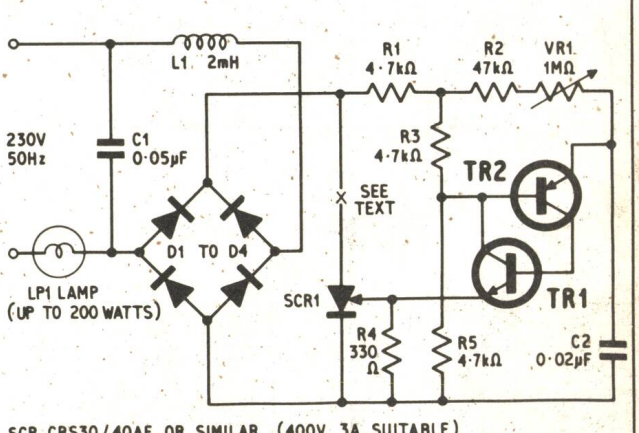


Fig. 10. Lamp dimmer—full wave control (S.T.C. Ltd.)

smooth operation. This is done in one case by using two thyristors, each exercising control on alternate half-cycles, while in the other a full wave bridge rectifier is used to enable one thyristor to control both half-cycles.

Circuits are given in Fig. 9 and Fig. 10.

TWO-THYRISTOR CIRCUIT

Dealing with the SGS circuit first, consider that part above the dotted line and including the variable resistor VR1. Positive going half-cycles at D1 anode are shifted in phase by VR1 and C4, but here extra phase shift is added by R4 and C3, so giving control of SCR1 gate firing over the whole half-cycle instead of a maximum of 90 degrees as previously described.

On the other half-cycle the remainder of the circuit behaves in a similar manner, using VR1 as phase shift control, and smooth variation of lamp brilliance is given from full brilliance to zero output.

SINGLE-THYRISTOR CIRCUIT

Turning now to the circuit from S.T.C. (Fig. 10), it will be seen that only one thyristor is used, together with a full wave bridge rectifier to supply only positive voltages to the anode.

If we imagine the thyristor already to be conducting, the output of the bridge will be short circuited, but with the lamp in series with the mains input it will drop nearly all the applied voltage and be at full brilliance. Variable delay of thyristor conduction in each half-cycle will give control of lamp brilliance; this control is achieved by charging C2 through R2 and VR1.

When the voltage across C2 and hence at TR2 emitter exceeds that at its base by more than about 0·6V, TR2 conducts, so passing current to TR1 base and this complementary pair of transistors rapidly turns to a state of conduction. Thus the positive voltage on C2 is suddenly applied to the thyristor gate, so switching it on. The point in the half-cycle at which it does so is set by the time taken for C2 to charge to the required voltage, through VR1. Once again, very smooth control of lamp brilliance is given.

DUPLICATE CIRCUITS

A variation of this particular circuit (Fig. 10) is to put the lamp at X, in the anode of the thyristor and apply the mains direct to the bridge. This will give d.c. in the lamp, but this is of no consequence. However, what is interesting is that duplicate thyristors, each with their own control circuits, can be run from the same bridge rectifier, each thyristor having a lamp (or other load) in its anode circuit.

By this means a multitude of lamps, for theatrical work, shop window displays and so on can very easily be controlled, *independently*. The bridge must of course be of adequate rating, that is, be capable of carrying the total lamp current with all lamps at maximum brilliance.

Besides the thyristors quoted in the circuits, unmarked devices have proved successful in both cases, although some slight adjustment of resistor or capacitor values may be called for to obtain full control.

The transistors used should be silicon for low leakage, and a variety of types will function well—BSY95A, 2N929, 2N3704, BSY27 for the *npn;* the OC200 series and 2N3702 for the *pnp* have all proved suitable.

RADIO INTERFERENCE

One important point which should be mentioned here is the question of radio interference. Since thyristors by their very nature switch on rapidly, many harmonics are produced and these may give rise to interference, especially if a controller is run from the same mains socket outlet as a television or radio, on which a pronounced 50 or 100Hz buzz will be heard.

Some form of suppression is required, and that depicted in Fig. 10 is typical, where L1 and C1 act as a filter, is an example of what could be used.

The construction of controllers and similar devices using circuits such as described here is best carried out in metal boxes which can be earthed, thereby reducing the radiation of interference, as well as giving greater safety.

AUTOMATIC LIGHTING CONTROL

Continuous control of lamp output has a multitude of uses—porch lights can be run dimmed, to be turned up when needed, lights can be turned down for watching television, or for parties, and photographers will be able to control studio lighting and enlarger lamps. Extra lamp life is a useful by-product of under running of course.

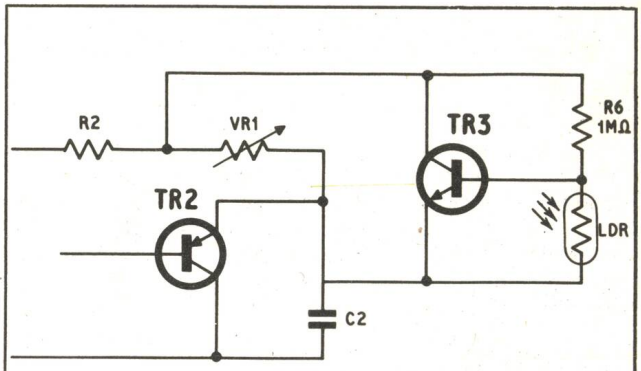


Fig. 11. Automatic Light control modification to circuit given in Fig. 10

Automatic control of lamp brilliance, depending on the level of ambient lighting, so that lights come on at dusk for example, is a desirable feature, and a modification to the circuit of Fig. 10 to carry this out is given in Fig. 11.

With VR1 set for low light output and the light dependent resistor (LDR) at minimum resistance, say 10 kilohm, the transistor TR3 will be cut off, that is it will present a high resistance between collector and emitter and hence it will hardly shunt VR1. As the LDR resistance increases up to about 300 kilohm or more with reduction in light level, the transistor conducts and shunts VR1, hence switching on the thyristor earlier in each half-cycle and turning up the lights. A suitable LDR would be cadmium sulphide (CdS) type; the transistor can be any ordinary silicon *npn* type, such as a BSY 95A.

Circuits for switching on lights as the ambient light level falls have appeared in PRACTICAL ELECTRONICS before, but that given above has the twin advantages of gradual turn on as daylight falls and of being contactless —previous circuits have usually used relays.

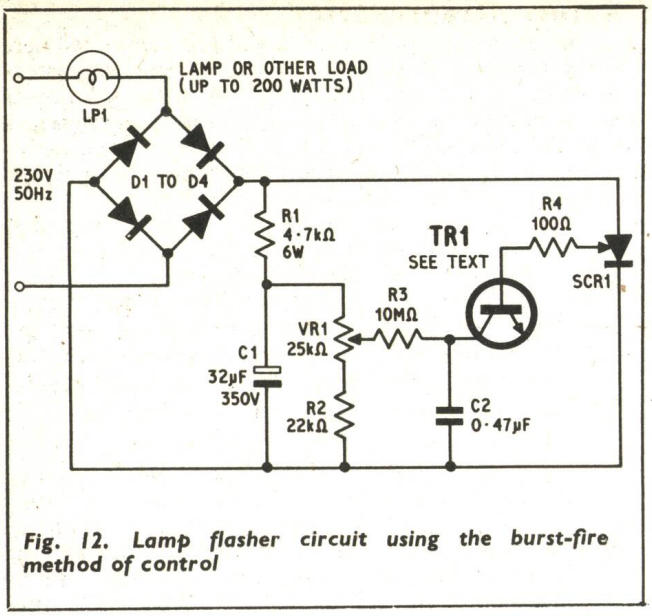


Fig. 12. Lamp flasher circuit using the burst-fire method of control

HEATING CONTROL

Similarly, the LDR could be replaced by a temperature dependent resistor, or thermistor; the temperature of aquaria, chemical solutions and so on will then be governed very efficiently. With a suitable thyristor and diodes, control of electric room heating is possible.

Remember that each kilowatt to be controlled will pass just over 4A through the thyristor and half that amount through each bridge diode; adequate surge rating is called for when switching on cold heating elements. The higher power thyristors, say 10A and upwards, may require larger gate currents than that given by the circuits here.

The circuits so far described use the "phase-shift" method of thyristor operation. The next circuit introduces a form of "burst-fire" control.

FLASHING CIRCUITS

Continuing with a.c. circuits, that of Fig. 12 will provide flashes lasting about a quarter of a second, with a repetition rate determined by the setting of the 25kΩ potentiometer VR1. With the values and thyristor shown, this can be varied from one flash every second to one every five seconds. A lower value for R3, say 4·7 megohms will quicken the rate of flashing; an increase in the value of C2, say to 1μF, will slow the rate to about one flash every nine seconds.

Flashes lasting longer than the quarter-second noted above will be obtained if C1 is increased, say to 64μF. With the potentiometer slider at the lower end a flash of about 0·6 second alternating with a space of 0·5 second gives an effective display, useful for warning lights and so on.

The use of a transistor TR1 in the gate lead of the thyristor is worthy of a mention. Connected as shown (Fig. 12), with its emitter left disconnected, very little current, certainly less than 10μA, will flow to the thyristor gate as long as the voltage across the collector-base junction is fairly small. This low level of current is insufficient to switch on the thyristor.

As C2 charges, this collector-base voltage rises until avalanche breakdown occurs, at around an applied voltage of 30 to 35 volts, when the transistor conducts suddenly and connects C2, charged to that potential, to the thyristor gate. The thyristor immediately conducts, discharging C2 for the cycle to repeat. The 100 ohm resistor R4 limits the current through the transistor.

No damage or change of important characteristic has been noted in this transistor, which may, in any case, be an inexpensive silicon *npn* such as a BSY 95A. The thyristor quoted is a BTY 79400R; an unmarked 400V 3A device worked also but various samples gave slightly varying repetition rates.

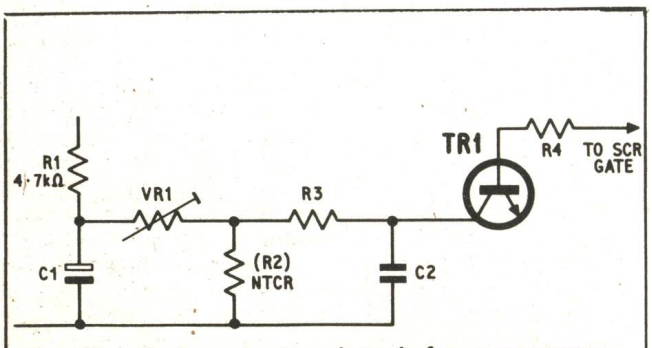


Fig. 13. Flasher circuit adapted for temperature control

TEMPERATURE CONTROL

A use for this circuit, besides the obvious one of a flashing light for display purposes and so on—without moving parts and exposed contacts of course—is the possibility of close temperature control; see Fig. 13.

Replace the 22 kilohm (R2) resistor by a suitable negative temperature coefficient resistor, placed in the environment to be controlled, say an aquarium. With the water cold, the NTC resistor will have a large resistance, and the repetition rate of the thyristor firing will be high. The thyristor load is, of course, the aquarium heater. As the water warms, the NTC resistor will decrease in value and the repetition rate will accordingly fall, so passing, averaged over some seconds, less heat to the water.

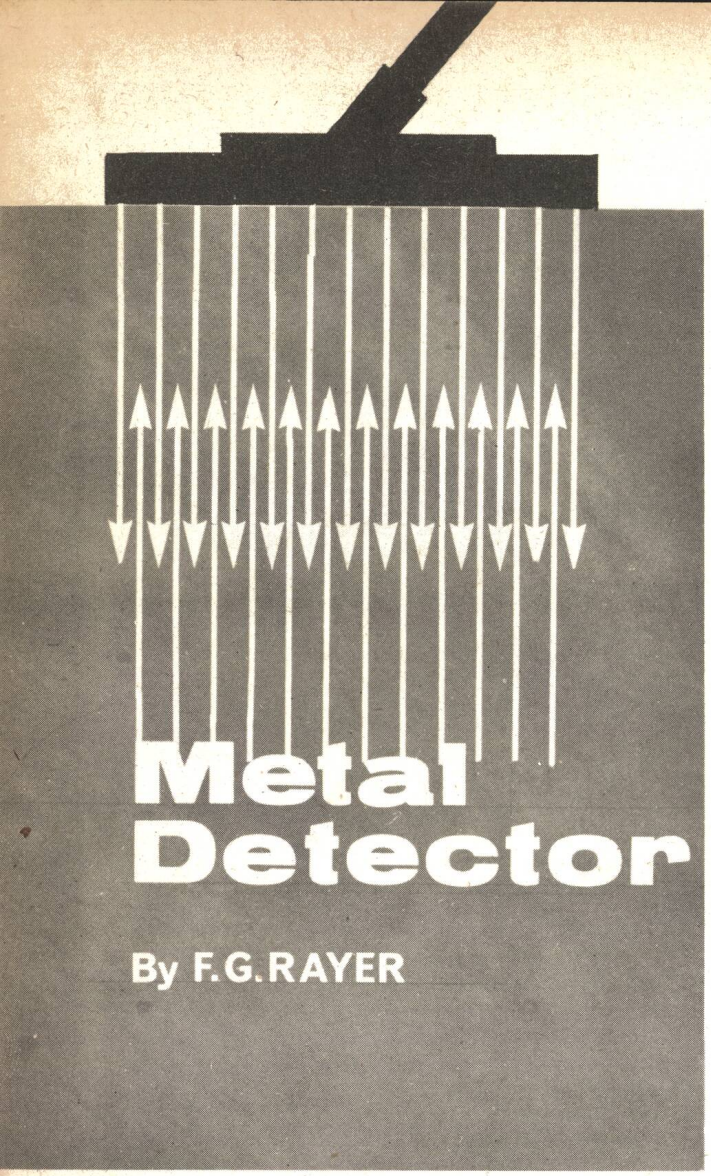
Control of water temperature is thus close and perhaps more important, rapid, since the set-up responds to NTC resistor changes immediately and continuous control is maintained. These are important improvements over an ordinary on-off thermostat, in aquaria, plating baths, photographic processing solutions and so on.

A disadvantage is that since the duty cycle of heating is no greater than say, 50 per cent, even at maximum heat output, a larger heating element is needed. In the author's opinion, it is worth while to gain the advantages mentioned; a by-pass switch could put continuous heating on if required for rapid warm up from cold.

PHASE-SHIFT v. BURST-FIRE

The phase-shift method, as described in connection with circuits for lamp dimming, can give a certain amount of r.f. interference due to the rapid turn on of the thyristor sometime during each half-cycle of mains input, that is, at a rate of 100Hz. The steps necessary

continued on page 31



Metal Detector

By F.G.RAYER

THE device described in this article can help to locate concealed metal, under paving or the earth, under floors, or behind walls. The search coil and detector are attached to a wooden handle, so can be moved about over the ground. The maximum distance to which a metal object can be located depends on the adjustment of the circuit, and also circumstances, such as the presence of other metal objects, size of the metal to be located, and to some extent on materials which may lie between the metal and search coil.

RANGE

The range at which detection could be secured was up to about 6in from a small metal item such as a coin, extending to about 1ft 6in for a metal object having an area of about ½ sq ft or larger. Long items of small width, such as small pipes or wires, can only be detected at short range. The kind of metal, and the ability of the user to note a small change in tone, also influences the maximum possible range.

Moving the search coil near a large mass of wet earth changes the tone, but a manual control allows adjustment for this. In such circumstances the search coil should be moved at a uniform distance from the ground, or regularly in contact with it.

DETECTOR CIRCUIT

Two r.f. transistors are used in a heterodyne circuit (Fig. 1) with a further transistor as an audio amplifier. L1 is the search coil, with collector and base tappings, and tuned by the fixed capacitor C4.

The second oscillator is built around a cored coil L2. The frequency is initially set by adjusting the core and trimmer VC1. The circuit can then be tuned over a narrow band by the manual control VC2.

The r.f. output from TR1 and TR2 is coupled to the detector D1 by small capacitances C2 and C7. TR3 provides audio amplification, with base bias secured by the rectified signal through D1.

The coils L1 and L2 are each tuned to about 550kHz. When L1 and L2 are operating at the same frequency, no beat note is produced or heard in the phones. The presence of metal near the large search coil L1 detunes its frequency, producing a heterodyne beat heard in the phones. The change of frequency increases as the metal object is approaching the coil, and falls as the distance between coil and object grows larger again.

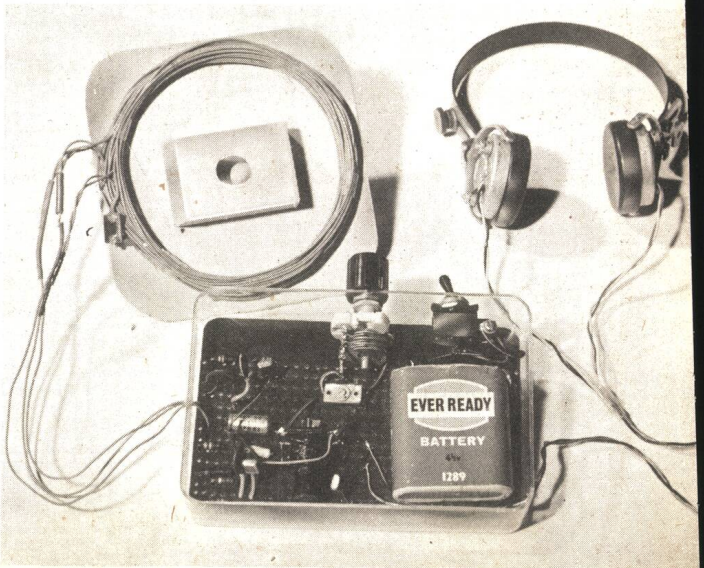
SENSITIVITY

For most sensitive results, VC2 is tuned so that a low audio tone is heard with no metal near L1. The tone then changes when metal is approached. If both tuned circuits are set to exactly the same frequency to begin with, "pulling" of one circuit by the other reduces sensitivity. This effect can be made less serious by reducing the values of C2 and C7, but volume then becomes rather low. It is thus better to work with a constant tone.

The gain of the audio amplifier has no bearing on the range of detection, but boosts detector output to a suitable level. The single audio stage was found sufficient, using 4,000 ohm headphones.

ASSEMBLY

The detector is wired on an s.r.b.p. panel which should fit in a plastics box (Fig. 2), 7in × 4½in × 1½in deep.



Top left—the search coil; top right—the headphones; bottom—the electronic detector

Merry Christmas from Antex

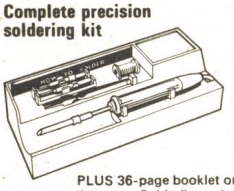
A·N·T·E·X

PRECISION miniature soldering iron for transistors and printed circuits

Merry Christmas

A choice of Practical Christmas gifts for amateur or professional

Complete precision soldering kit



This kit—in a rigid plastic "tool-box" — contains

- Model CN 15 watts miniature iron, fitted 1/8" bit. Interchangeable spare bits. 3/32". 3/32".
- Reel of resin-cored solder
- Felt cleaning pad
- Stand for soldering iron

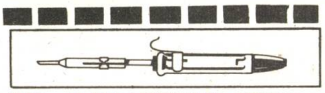
PLUS 36-page booklet on "How-to-Solder"—a mine of information for amateur and professional.

From Electrical and Radio Shops or send cash to Antex. 49/6

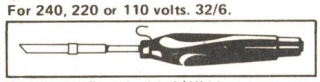
Attractively gift wrapped.

Model CN 240/2
15 watts - 240 volts
Fitted with nickel plated bit (3/32") and in handy transparent pack. From Electrical and Radio Shops or send cash to Antex. **31/-**

Attractively gift wrapped.

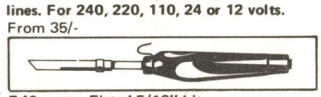


G 18 watts. Fitted 3/32" bit for miniature work on production lines. Interchangeable spare bits, 1/8", 3/16" and 1/4" available. For 240, 220 or 110 volts. 32/6.



E 20 watts. Fitted with 1/4" bit. Interchangeable spare bits 3/32", 1/8", 3/16" available. For 240, 220, 110 volts. From 35/-

ES 25 watts. Fitted with 1/8" bit. Interchangeable bits 3/32", 3/16" and 1/4" available. Ideal for high speed production lines. For 240, 220, 110, 24 or 12 volts. From 35/-



F 40 watts. Fitted 5/16" bit. Interchangeable bits 1/4", 3/16", 1/8", 3/32" available. Very high temperature iron. For 240, 220, 110, 24 or 20 volts. From 42/6
Spare bits and elements for all models and voltages immediately available from stock.

A N T E X

PRECISION MINIATURE SOLDERING IRONS

Antex, Mayflower House, Plymouth, Devon.
Telephone: Plymouth 67377/8.
Telex: 45296. Giro No. 2581000.

☐ Please send me the Antex colour catalogue

☐ Please send me the following irons

Quantity Model Bit Size Volts Price

....

....

....

I enclose cheque/P.O./cash value

.....

NAME .....

ADDRESS .....

..... PE 1

0·0005 mFd TUNING CONDENSER
Proved design, ideal for straight or reflex circuits. **2/6** each. **24/-** doz.

ELLIOT SEALED CONTACT REED RELAY

Three circuits closed by 3V or 100 MA. **9/6** each.

SLIM TUBULAR MICROPHONE
For hand holding or frontal suspension—lever switch—high impedance with lead and plugs for cassette tape recorder but suitable for most amplifiers. **19/6.**

750 MICRO AMP MOVING COIL METER
2½in ex-W.D. but brand new and unused **19/6.**

HIGH CAPACITY ELECTROLYTICS
Brand new, not ex-equipment. 100mF 25V **1/3** each, **12/-** doz.; 200mF 25V **1/6** each, **15/-** doz.; 500mF 12V **2/-** each, **£1.1.0** doz.; 1,000mF 12V **3/-** each, **£1.10.0** doz.; 5,000mF 12V **4/9** each, **£2.8.0** doz.; 10,000mF 6V **5/9** each, **£3.0.0** doz.; 10,000mF 15V **8/6** each, **£4.10.0** doz.; 15,000mF 10V **10/6** each, **£5.0.0** doz.; 60,000mF 8V **22/-** each, **£10.0.0** doz.; 70,000mF 13V **40/-** each, **£20.0.0** doz.

TOGGLE SWITCH

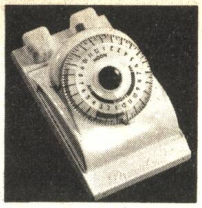
3 amp 250V with fixing ring **1/6** each, **15/-** doz.

3-CORE WATERPROOF FLEX
6A, 23/0076 circular PVC covered as fitted to electric drills and most portable appliances, ideal extension lead. Regular price 1/6 per yard, our price **79/6** for 100 yard coil. Post 6/6.

5A, 3 PIN SWITCH SOCKETS

An excellent opportunity to make that bench dis board you have needed or to stock up for future jobs. This month we offer 6 British made (Hicraft) bakelite flush mounting shuttered 5A switch sockets for only **10/-** plus 3/6 post and insurance. (20 boxes post free.)

BLACK LIGHT
G.E.C. tube for experiments and special lighting effects—40 watt 2ft tubes only. **18/6** each; holders and control gear **19/6**, postage on single item **4/6** inc. insurance, or both items ordered together postage **6/6** inc. insurance.

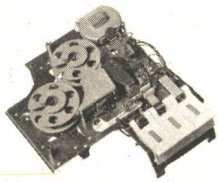


DREAMLAND CLOCK SWITCH
The wonderful DREAMLAND mains operated clock switch will automatically switch your blanket on and off each evening and you will always have a warm bed. It's luminous; you can always see the time and it's a really beautiful unit. An ideal gift. Can also control tape recorder, radio, lamp, etc., up to 500 watts. **39/6** plus 3/6 post and ins.

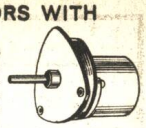
PROTECT VALUABLE DEVICES

FROM THERMAL RUN-AWAY OR OVER-HEATING: Thyristors, rectifiers, transistors, etc., which use heat-sinks can easily be protected. Simply make the contact thermostat part of the heat-sink. Motors and equipment generally, can also be adequately protected by having thermostats in strategic spots on the casing. Our contact thermostat has a calibrated dial for setting between 90 deg. to 190 deg. F. or with the dial removed range setting is between 80 to 800 deg. F. Price **10/-.**

Horstmann "Time and Set" Switch
(A 15 amp Switch.) Just the thing if you want to come home to a warm house without it costing you a fortune. You can delay the switch on time of your electric fires, etc., up to 14 hours from setting time or you can use the switch to give a boost period of up to 3 hours. Equally suitable to control processing. Regular price probably around £5. Special snip price **29/6**, p. & ins. 4/6.



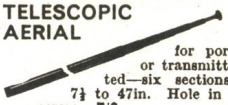
BATTERY OPERATED TAPE DECK
With Capstan control. This unit is extemely well made and measures approx. 6 × 5 × 2in. deep. Has three piano key type controls for Record, Playback and Rewind. Motor is a special heavy duty type intended for operation off 4/5 volts. Supplied complete with 2 spools ready to install. Record, Replayhead is the sensitive M4 type intended for use with transistor, amplifier. Price **79/6.** Post and insurance 4/6

INSTRUMENT MOTORS WITH GEARBOX

Made by famous Smiths Company. Very poweful, although only quite small. Overall dimensions approx. 1½in deep by 2in dia. Available with the following speeds. —Revs. per day; 2–8–12. Revs. per hour; 1, 2, 4, 6, 12, 20, 30. Revs. per minute; 1, 2, 3, 4, 6, 8, 15, 30, 60. **17/6** each.

BLANKET SWITCH

Double pole with neon let into side so luminous in dark, ideal for dark room light or for use with waterproof element—new plastic case. **5/6** each. 3 heat model **7/6.**

PHOTO-ELECTRIC KIT
All parts to make light operated switch/burglar alarm/counter, etc. Kit comprises printed circuit. Laminated Boards and chemicals. Latching relay. Infra-red sensitive Photocells and Hood, 2 transistors, cond., terminal block. Plastic case. Essential data, circuits and P.C. chassis plans of 10 photo-electric devices including auto. car parking light, modulated light alarm. Simple invisible ray switch—counter—stray light alarm—warbling tone electronic alarm—project lamp stabiliser, etc., etc. Only **39/6,** plus 2/- post and insurance.

TELESCOPIC AERIAL

for portable, car radio or transmitter. Chrome plated—six sections, extends from 7½ to 47in. Hole in bottom for 6BA screw. **7/6.**

M.W. SIGNAL GENERATOR
Complete kit as described in November's issue, **12/6** each.

80 OHM BALANCED ARMATURE EAR PIECE
Usable as microphone or loudspeaker, **4/6** each.

MINIATURE EAR PIECE
As used with imported pocket radios, **1/6** each, **15/-** doz.

Where postage is not stated then orders over £3 are post free. Below £3 add 2/9. Semiconductors add 1/- post. Over £1 post free. S.A.E. with enquiries please.

ELECTRONICS (CROYDON) LTD
Dept. PE, 266 London Road, Croydon CRO 2TH
Also 102/3 Tamworth Road, Croydon

INTEGRATED CIRCUIT F.M. TUNER KIT

Dart Electronics has been appointed by General Avionics Limited as their U.K. distributor for their FM Tuner kit, the first to use integrated circuits with pulse counting techniques developed by Marconi-Elliott Microelectronics.

The circuit has built-in automatic frequency control, and with the inherent stability of the integrated circuits, a reliable and easily set up circuit is offered to the home constructor in kit form. A resistively tuned version is in widespread use as an industrial radio system and is noted for its extreme reliability under continuous, unattended operation. The circuit employed effectively contains 44 transistors and, although the quantity of discrete components is fairly high, the entire unit is built on a double-sided board measuring 133 × 98·5mm (3·875 × 5·25in). The Tuner can be run off a 12V d.c. power supply or a combination of 6 and 12V batteries.

All components are available BY POST ONLY from Dart Electronics at a special kit price of **£9 19s 6d** plus 5/– post and packaging (U.K. & N. Ireland) which includes selector switch and double-sided p.c. board ready drilled and tinned. The kit is complete with all necessary circuits and instructions.

Full assembly details, circuit diagram and parts list are also available separately from Dart Electronics at **2/6** per copy and an article appeared in the June issue of the WIRELESS WORLD magazine.

DART ELECTRONICS P.O. BOX No. 47, WITHAM, ESSEX

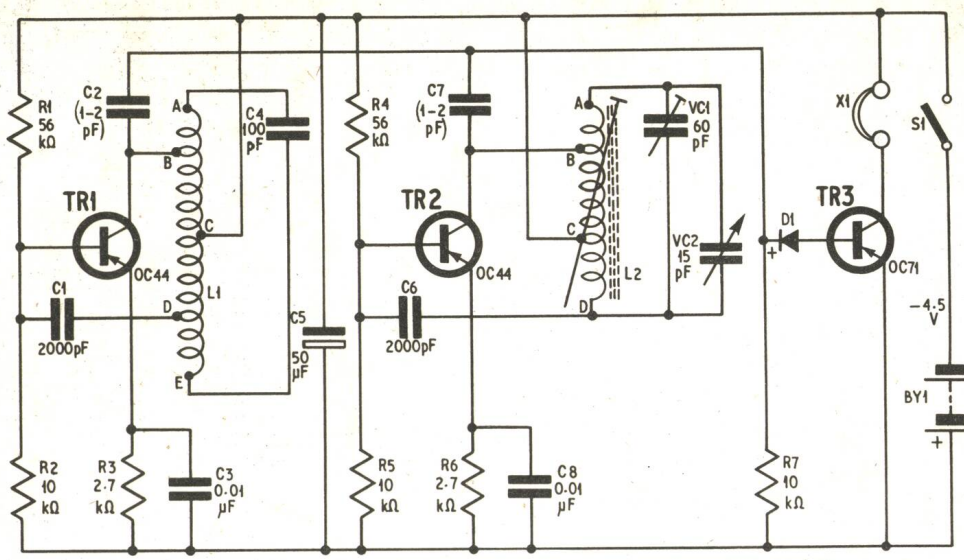


Fig. 1. The complete circuit diagram of the metal detector

COMPONENTS . . .

Resistors

R1 56kΩ
R2 10kΩ
R3 2·7kΩ
R4 56kΩ
R5 10kΩ
R6 2·7kΩ
R7 10kΩ
All ±10%, ¼W carbon

Capacitors

C1 2,000pF
C2 2pF ceramic
C3 0·01μF
C4 100pF mica
C5 50μF elect. 12V
C6 2,000pF
C7 2pF ceramic
C8 0·01μF

Variable capacitors

VC1 60pF compression trimmer
VC2 15pF air space variable control

Inductors

L1 uses p.v.c. covered single core bell wire, about 20 yards (see text)
L2 uses 32 s.w.g. enam. copper wire, about 10 yards and a ½in or 10mm coil former with dust iron core (see text)

Transistors and Diode

TR1, 2 OC44 *or* NKT152 (2 off)
TR3 OC71 *or* NKT251
D1 OA79, OA81, or similar

Miscellaneous

S1 Single-pole, on-off toggle switch
X1 Headphones, 4,000Ω type
BY1 Battery 4·5V type 1289
Plastics box, perforated s.r.b.p. 6½ × 4¼
Tinned copper wire and p.v.c. covered flexible wire
Wood for detector sensor and handle (see text)

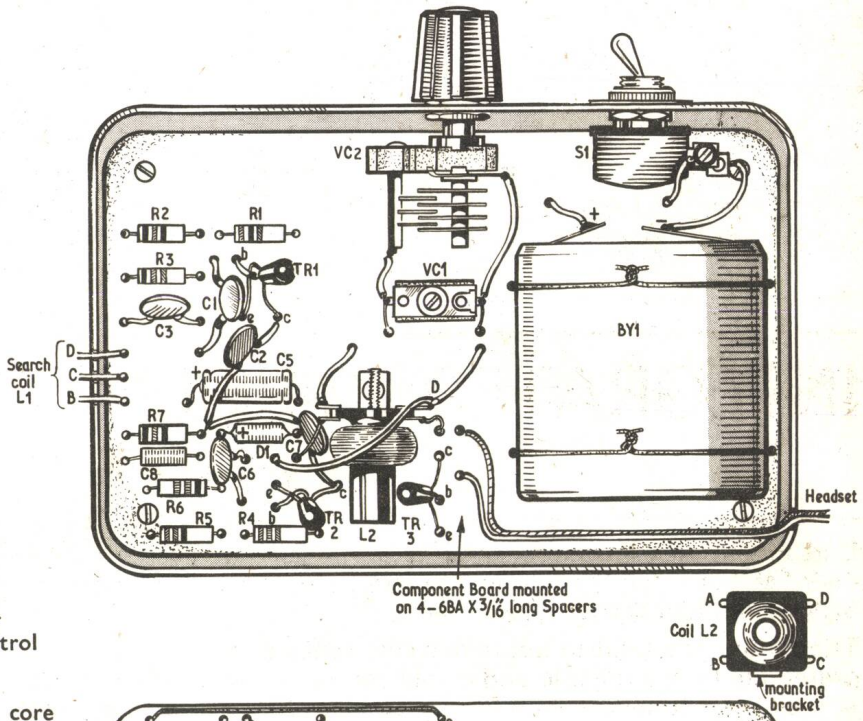


Fig. 2. The electronic unit is mounted in a plastics box. The component side and underside wiring of the board are shown above

The wire ends of the components pass through small holes, and are soldered underneath to 24 s.w.g. wire connections. Insulation is placed on leads where necessary.

The 4·5V battery is secured with cord or wire passed through holes in the component board. Leads are soldered on. Polarity must be correct.

The switch and VC2 are fitted after placing the wired panel in the box. Long leads for the search coil pass through a hole in the box end and are taped to the handle down to the search coil at the bottom.

The capacitors C2 and C7 can be 2pF fixed ceramic types, or be made from thin insulated wire about 1½in long and twisted together.

COIL WINDING

The oscillator coil L2 is wound from 32 s.w.g. enamelled wire on a ½in or 10mm diameter former with an adjustable core. The winding begins at A, Fig. 2. This end will go to VC1 and VC2, Fig. 2, after the coil is wound and mounted. For the first section, A to B, wind on 125 turns, in a compact pile. Make a loop of the wire about 3in long at B. Continue winding in a pile in the same direction for a further 45 turns, and make another loop at C (battery negative). A further 15 turns in the same direction finishes the coil; this end (point D) goes to VC1, VC2 and C6.

Do not let the loops cause the coil windings to come loose. Turns are held with a little adhesive or wax. When firmly set the loops at A, B, C, and D are bared for about ½in and soldered to the appropriate junctions on the component board, or via the tags on the former if fitted.

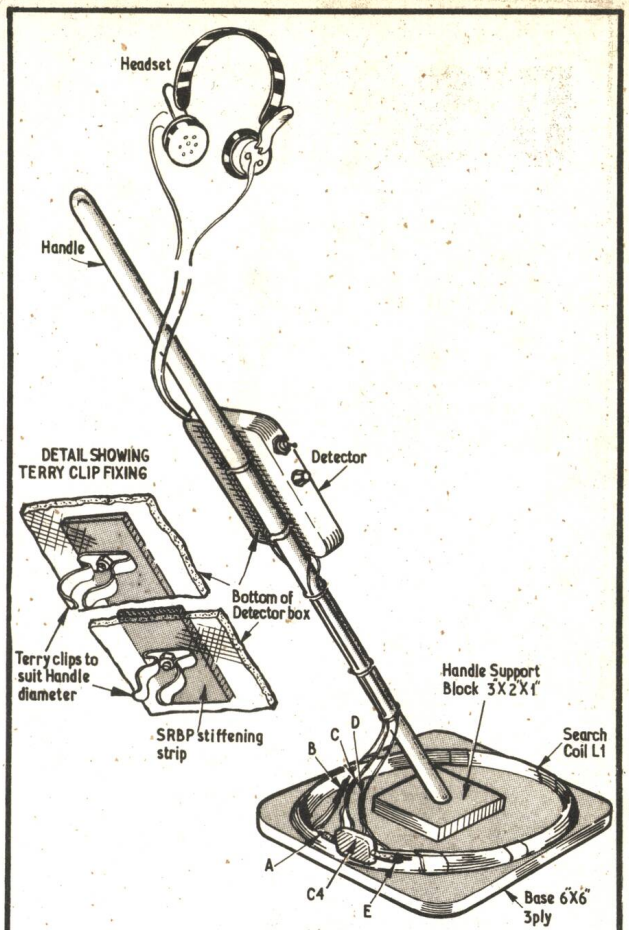


Fig. 3. Construction details of the search coil. Make sure that the Terry clip fixings do not touch the wiring

SEARCH COIL

The search coil L1 is wound with thin single core bell wire and is 5in in diameter. A temporary former of near this diameter is used to wind the coil, winding 10 turns from A to B. A loop is made at B and winding continues for another 12 turns to loop C. Wind four turns more, make loop D, then wind 15 turns more, and end at E. The ends and loops should be identified by coloured sleeving or other means. The insulation is removed for about ½in for connection to the long leads from the box.

The coil is removed from its temporary former, and bound with adhesive tape. It is attached by adhesive to a piece of 3-ply wood about 6in × 6in, Fig. 3. C4 is soldered to the ends of the coil at points A and E.

ASSEMBLY OF SEARCH COIL

A block of 1in thick wood about 2in × 3in is drilled at an angle to take a thick dowel or broom handle, Fig. 3. This is glued in place, and the block is glued to the centre of the plywood plate.

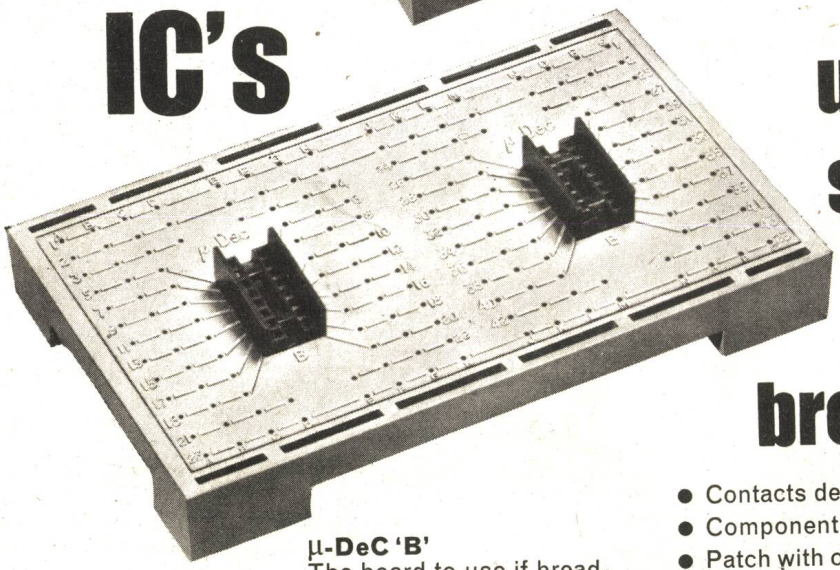
The detector can be fitted to the handle about 1ft up the handle by means of two Terry clips bolted to the box. The search coil leads B, C and D (Fig. 2) are arranged to run down to the tappings, and are secured with tape or thread to the handle.

DISCRETE

or

T-DeC
Primarily for discrete components but with IC capability.

IC's



μ-DeC 'B'
The board to use if breadboarding with one package type.
If breadboarding with a variety of packages use μ-DeC 'A' general purpose breadboards.

use DeC solderless modular breadboards

- Contacts designed for maximum life.
- Components inserted directly into board.
- Patch with ordinary wire.
- Modular, for economy and maximum use.
- Modules link to form any size of breadboarding.
- Slots accommodate heat sinks and control panels.
- Control panel supplied with every DeC.
- DeC's may be temperature cycled.
- Contacts available in a range of surface finishes.
- All contacts numbered for reference.
- All connection points shown on surface of DeC.

S.D.C. ELECTRONICS (SALES) LTD.

34 Arkwright, Astmoor Industrial Estate, Runcorn, Cheshire. Tel: Runcorn 5041.

VARIABLE VOLTAGE TRANSFORMERS

◀ 50 AMPS

INPUT 230/240v. A.C. 50/60— OUTPUT VARIABLE 0-260v.

BRAND NEW
Keenest prices in the country. All Types (and Spares) from ½ to 50 amp. from stock.

SHROUDED TYPE
1 amp, £5. 10. 0. 2.5 amps, £6. 15. 0. 5 amps, £9. 15. 0. 8 amps, £14. 10. 0. 10 amps, £18. 10. 0. 12 amps, £21. 0. 0. 15 amps, £25. 0. 0. 20 amps, £37. 0. 0. 37.5 amps, £72. 0. 0. 50 amps, £92. 0. 0.

½ AMP ▶ **£3.10.0**

OPEN TYPE (Panel Mounting)
½ amp, £3.10.0. 1 amp, £5.10.0. 2½ amps, £6.12.6.

STROBE! STROBE! STROBE!

Build a Strobe Unit, using the latest type Xenon white light flash tube. Solid state timing and triggering circuit. 230/250v. A.C. operation.

EXPERIMENTERS' ECONOMY KIT
1 to 36 Flash per sec. All electronic components including Veroboard S.C.R. Unijunction Xenon Tube and instructions **£5.5.0** plus 5/- P. & P.

NEW INDUSTRIAL KIT
Ideally suitable for schools, laboratories, etc. Roller tin printed circuit. New trigger coil, plastic thyristor 1-80 f.p.s. Price **9 gns.** 7/6 P. & P.

HY-LYGHT STROBE
This strobe has been designed and produced in response to wide public demand, for use in large rooms, halls and the photographic field. It has four times the light output at 30 f.p.s. and utilizes a silica plug-in tube for longer life expectancy, printed circuit for easy assembly, also a special trigger coil and output capacitor. Light output approx. 4 joules. Price **£10.17.6.** P. & P. 7/6.

7-inch POLISHED REFLECTOR
Ideally suited for above Strobe kits. Price **10/6.** P. & P. 2/6 or Post Paid with kits.
Several types of Flash Tubes available from stock.

100 WATT POWER RHEOSTATS (NEW)

AVAILABLE IN THE FOLLOWING VALUES:
1 ohm, 10 a.; **5 ohm,** 4.7 a.; **10 ohm,** 3 a.; **25 ohm,** 2 a.; **50 ohm,** 1.4 a; **100 ohm,** 1 a.; **250 ohm,** .7 a.; **500 ohm,** .45 a.; **1 Kohm,** 280 mA; **1·5 Kohm,** 230 mA; **2·5 Kohm,** .2 a.; **5 Kohm,** 140 mA. Diameter 3½in. Shaft length ⅞in., dia. ⅛in. All at **27/6** each. P. & P. 1/6.
50 WATT. 1/5/10/25/50/100/250/500/1/1·5/2·5/5 Kohm. **All at 21/- each.** P. & P. 1/6.
25 WATT. 10/25/50/100/250/500/1/1·5/2·5 Kohm. **All at 14/6 each.** P. & P. 1/6.

VEEDER ROOT, 230V a.c. 50 cycle, 5-figure counter (non-resettable). **18/6,** P. & P. 1/6.

Large Digit 12-18 V D.C. MAGNETIC COUNTER. 4in drum calibrated 0–9. Figures 1½in high, ¾in wide. Set of 1m, 1b; 1c/o contacts operated by drum cam. The units which can be used in multiples are ideally suited for batch or lap recording or for the many purposes where large easily read numerals are required. Price **18/6,** P. & P. 2/6.

BODINE TYPE N.C.1 GEARED MOTOR
(Type 1) 71 r.p.m. Torque 10lb. inch. Reversible. 1/70th h.p., 50 cycle, ·38 amp.
(Type 2) 28 r.p.m. Torque 20lb. inch. Reversible. 1/80th h.p., 50 cycle, ·28 amp.
The above two precision made U.S.A. motors are offered in 'as new' condition. Input voltage of motor 115v. A.C. Supplied complete with transformer for **230/240v. A.C. input.** Price, either type **£2. 17. 6** plus 6/6 P. & P. or less transformer **£2. 2. 6** plus 4/6 P. & P.

R.C.A. plastic triac 400 PIV 8 amp. Price **25/6** R.C.A. Diac for above, price **6/-.** *Prices include data sheet and circuit.*

G.E. P.U.T. D13 T1. **12/-.** Texas F.E.T. 2N3819 **7/6.**

New plastic thyristor 400 PIV 8 amp. **18/6** incl. data sheet.

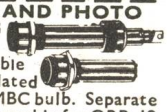
All above prices plus 1/6 P. & P.

VAN DE GRAAF ELECTROSTATIC GENERATOR
230V A.C. giving a potential of approx. 50,000V. complete including accessories for carrying out a number of interesting experiments, and full instructions. This instrument is completely safe, and ideally suited for School demonstrations. Price **£7.7.0,** plus 4/- P. & P. *L't. on req.*

LIGHT SENSITIVE SWITCH

Kit of parts, including ORP12 Cadmium Sulphide Photocell, Relay, Transistor and Circuit, etc., 6-12 volt D.C. op. price **25/-** plus 2/6 P. & P. ORP 12 including circuit, **10/6** each. plus 1/- P. & P.
A.C. MAINS MODEL. Incorporates Mains Transformer, Rectifier and special relay with 2 5 amp mains c/o contacts. Price inc. circuit **47/6** plus 2/6 P. & P.

LIGHT SOURCE AND PHOTO CELL MOUNTING



Precision engineered light source with focusible lens assembly and ventilated lamp housing, to take MBC bulb. Separate photo cell mounting assembly for ORP. 12 or similar cell. Both units are single hole fixing. Price per pair **£2.15.0.** P. & P. 3/6.

RELAYS New SIEMENS, PLESSEY, etc. miniature relays at COMPETITIVE PRICES

Coil Ω	Working d.c. Volts	Contacts		Price
170	9-12	4 c/o H.D.		14/6
170	9-12	3 c/o + 1 H.D. c/o		12/6
280	6-12	2 c/o	I.B	14/6
700	12-24	2 c/o	I.B	12/6
700	16-24	4 c/o	I.B	15/6
700	16-24	4M 2B	I.B	12/6
2500	30-50	2 c/o H.D.	I.B	12/6
9000	40-70	2 c/o	I.B	10/-

H.D. Heavy Duty. POST PAID
I.B. = Including Base

MINIATURE RELAYS
9–12 volt d.c. 2 c/o 500 M.A. contacts. Size 1 × ⅝ × ½in. Price **11/6** post paid.
30-36 v d.c. 2 c/o 500 M.A. contacts. 3,200 ohm coil. Size 1 × ⅝ × ⅜in. **8/6.** Post paid.

230 VOLT AC RELAY LONDEX 4 c/o 3 amp contacts. **18/6** inc. base, post paid.

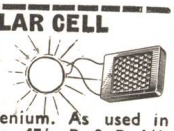
RING TRANSFORMER

Functional Versatile Educational
This multi-purpose Auto Transformer, with large centre aperture, can be used as a Double wound current Transformer, Auto Transformer, H.T. or L.T. Transformer, by simply hand winding the required number of turns through the centre opening. E.g. Using the RT. 100 V.A. Model the output could be wound to give 8V. @ 12½a., 4V. @ 25a., 2V. @ 50a., etc.
Price: RT.100VA 3.18 turns per volt, **£2.5.0** + 3/6 p. and p. RT.300VA 2.27 turns per volt, **£4.4.0** + 5/6 p. and p. RT. 1KVA 1.82 turns per volt, **£6.10.0** + 6/6 p. and p.

SANWA MULTI RANGE METERS

New Model U50D Multi tester, 20,000 OPV, mirror scaled with overload protection. Ranges—d.c. volts: 100mV, 0·5V, 5V, 250V, 1,000V; a.c. volts: 2·5V, 10V, 50V, 250V, 1,000V; d.c. current: 5μA, 0·5MA, 5MA, 50MA, 250MA. Complete with battery and test probe. **£7.5.0** post paid.

34R SILICON SOLAR CELL



4 × ·5 volt unit series connected, output up to 2V at 20mA in sunlight, 30 times the efficiency of selenium. As used in power Earth Satellites, **45/-,** P. & P. 1/6.

LT TRANSFORMERS
All primaries 220–240V

Type No.	Sec. Taps	Price	Carr.
1	30, 32, 34, 36V at 5A ..	£4.5.0	6/-
2	30, 40, 50V at 5A	£6.5.0	6/6
3	10, 17, 18V at 10A	£4.10.0	4/6
4	6, 12V at 20A	£5.17.6	6/6
5	17, 18, 20V at 20A	£6.12.6	6/6
6	6, 12, 20V at 20A	£6.5.0	7/6
7	24V at 10A	£4.15.0	5/6
8	4, 6, 24, 32V at 12A	£6.10.0	6/6

SERVICE TRADING CO

All Mail Orders—Also Callers—Ample Parking Space
57 BRIDGMAN ROAD, LONDON, W.4 Phone 995 1560
SHOWROOM NOW OPEN CLOSED SATURDAY

Personal callers only
9 LITTLE NEWPORT ST.
LONDON, W.C.2. Tel. GER 0576

TRANSISTOR AUDIO AND RADIO CIRCUITS

for Radio Receivers, Radiograms, Record Players, Tape Recorders and Hi-Fi Equipment.
A Mullard Publication
30/- Postage 1/-

PRACTICAL INTEGRATED CIRCUITS, by A. J. McEvoy & L. McNamara. **18/-.** Postage 1/-.

SERVICING WITH THE OSCILLOSCOPE, by Gordon J. King. **28/-.** Postage 1/-.

QUESTIONS AND ANSWERS TRANSISTORS, by Clement Brown. **10/-.** Postage 6d.

COLOUR TELEVISION PAL SYSTEM, by G. N. Patchett. **40-/.** Postage 1/-.

RADIO COMMUNICATION HANDBOOK, by Radio Society of Great Britain. **63/-.** Postage 4/6.

TRANSISTOR SUBSTITUTION HANDBOOK No. 9, 18/-. Postage 1/-.

S.C.R. MANUAL, by the General Electric Company. **25-/.** Postage 1/6.

TRANSISTOR MANUAL, by the General Electric Company. **21/-.** Postage 1/6.

THE MODERN BOOK CO.

BRITAIN'S LARGEST STOCKIST
of British and American Technical Books
19-21 PRAED STREET
LONDON, W.2
Phone: PADdington 4185
Closed Saturday 1 p.m.

NEW RANGE BBC 2 AERIALS

All U.H.F. aerials now fitted with tilting bracket and 4 element grid reflectors.

Loft Mounting Arrays, 7 element, **37/6.** 11 element, **45/-.** 14 element, **52/6.** 18 element, **60/-. Wall Mounting** with **Cranked Arm,** 7 element, **60/-.** 11 element, **67/-.** 14 element, **75/-.** 18 element, **82/6. Mast Mounting** with 2in. clamp. 7 element, **42/6;** 11 element, **55/-;** 14 element, **62/-;** 18 element, **70/-. Chimney Mounting Arrays, Complete,** 7 element, **72/6;** 11 element, **80/-;** 14 element, **87/6;** 18 element, **95/-.** Complete assembly instructions with every unit. **Low Loss Cable, 1/6** yd. **U.H.F. Pre-amps** from **75/-.** State clearly channel number required on all orders.

BBC · ITV AERIALS

BBC (Band 1). Telescopic loft, **25/-.** External S/D, **30/-.** "H", **£2.15.0.**

ITV (Band 3). 3 element loft array, **30/-.** 5 element, **40/-.** 7 element, **50/-.** Wall mounting, 3 element, **47/6.** 5 element, **52/6.**

Combined BBC/ITV. Loft 1+3, **40/-;** 1+5, **50/-;** 1+7, **60/-;** Wall mounting 1+3, **57/6;** 1+5, **67/6;** Chimney 1+3, **67/6;** 1+5, **75/-.**

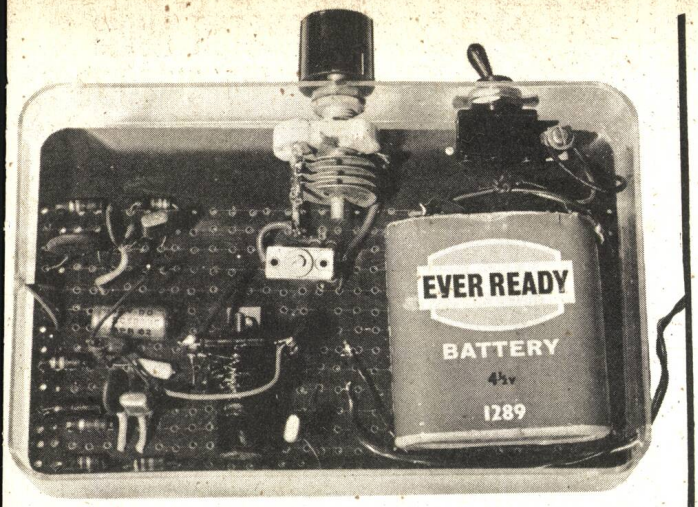
VHF transistor pre-amps, **75/-.**

COMBINED BBC1—ITV—BBC2 AERIALS 1+3+9, **70/.** 1+5+9, **80-/.** 1+5+14, **90/-.** 1+7+14, **100/-.** Loft mounting only. Special leaflet available.

F.M. (Band 2). Loft S/D, **15/-,** "H", **32/6,** 3 element, **55/-.** External units available. Co-ax. cable, 8d. yd. Co-ax. plugs, **1/4.** Outlet boxes, **5/-.** Diplexer Crossover Boxes, **13/6.** C.W.O. or C.O.D. P. & P. 6/-. Send 6d. stamps for illustrated lists.

CALLERS WELCOME
OPEN ALL DAY SATURDAY

K.V.A. ELECTRONICS (Dept. P.E.)
40-41 Monarch Parade
London Road, Mitcham, Surrey
01-648 4884



The complete detector unit ready for mounting on the handle and connecting to search coil

If it is required to dismantle the instrument for portability, the handle could be made a tight push fit into the block with a screw to secure it. Leads from the coil could terminate in a small 3-pin plug to insert in a socket on the detector box. A jack could be used for headphones.

ADJUSTMENTS FOR CORRECT OPERATION

No results can be obtained until the two tuned circuits are operating on a near frequency. Adjusting VC1, VC2 and the core of L2 throughout their full range should produce a heterodyne whistle in the phones. If so, adjust VC1 so that zero beat arises with VC2 about half closed. Rotating VC2 from this position, in either direction, should cause the tone to rise in pitch.

If no tone can be heard switch off and temporarily disconnect TR3, and use a meter to check battery current. This should change if C4 is shorted, or if VC2 is shorted. If there is no change in current when either of these tests is made, the appropriate oscillator is not working, and connections should be checked. When all is satisfactory reconnect TR3.

If both TR1 and TR2 are oscillating, but no tone is obtained, their frequencies are probably too far apart. One way of checking this is to take a 300pF variable capacitor, and temporarily connect it across L1 (A to E). If closing this capacitor enables a heterodyne to be produced, then the frequency of L1 is too high for L2 to match. This is corrected by increasing C4, or by reducing VC1, or having fewer turns on L2, or withdrawing the core, until VC1 and VC2 can be adjusted as described.

Should a heterodyne only be possible with extra capacitance across L2, then L2 is at too high a frequency. This can be overcome by reducing C4, or increasing the value of VC1, or screwing the core of L2 further in.

VC2 is best adjusted to give a low frequency tone in the headphones, and so that the frequency rises when L1 approaches the metal sought. If the tone falls, passes through zero, then begins to rise, VC2 can be retuned to the other side of zero beat when no metal is near L1.

★

THYRISTORS AND THE EXPERIMENTER

continued from page 23

to reduce radiation have been noted earlier and should be followed for minimum interference on radio and television.

The burst-fire control method, however, switches power to the load at a much lower rate, say every second for ½ second at a time, and hence the thyristor is required to switch on-load current that much less often. If additional circuitry is employed—rather too complex to include in the present article—then it is possible to arrange for the load to be both switched on and off at zero mains voltage, i.e. at almost zero load current, and in that case no interference can be generated.

OBJECTIONAL FLICKER

Although the potential interference level is much less using burst-fire, there is (of course!) a disadvantage. If used for lamp control there is a very pronounced, objectional flicker, although when used for the control of heaters this factor does not apply. Since heaters are generally of higher wattage, and so take more current than lamps, higher levels of interference would be generated using phase-shift control with them—hence the recommendation to use burst-fire when possible.

There is another objection to the use of the phase-shift method for high power control.

The phase-shift method introduces some distortion into the waveform of the electricity supply. If a number of high power devices were operating simultaneously in the same electricity supply area, this distortion could assume serious proportions, and affect other equipment connected to this area. For this reason, the Electricity Council recommends the use of the burst-fire method, except for low power devices such as light dimmers.

THE TRIAC

Before concluding, mention must be made of the Triac, which is equivalent to two thyristors in back-to-back parallel. Control of a.c. is possible using a single Triac and no rectifiers, but such devices are dearer than the equivalent thyristors at present. However, they will obviously make their bow in the home construction field before long, and will lead to simplification of circuitry.

SCOPE FOR EXPERIMENT

Since such a variety of circuits have been quoted in this review (most of which have either been tested, or actually evolved, by the author) it has not been possible to give here constructional details for the building of units making use of them. Rather it is hoped that experimenters will be encouraged to try some of the circuits in the applications mentioned, and to think of many more uses besides—the "Ingenuity Unlimited" pages are open to all! Thyristors are very easy to use once their principles are understood.

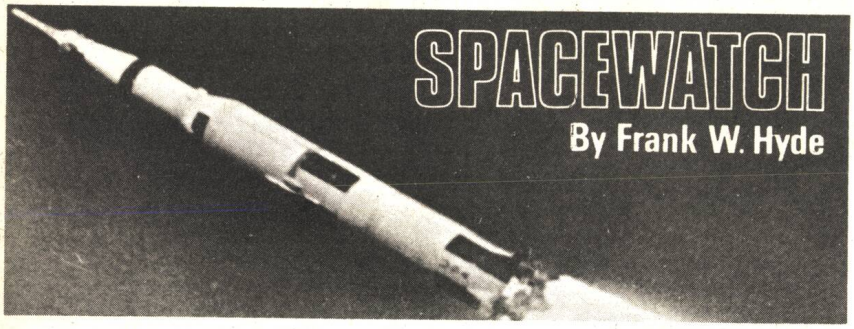
It would be as well to conclude by re-stating three important points:

1. Do not exceed the rating of the device in use—remember switch on surges, etc.

2. Provide adequate r.f. interference suppression such as an earthed metal case and/or a LC filter.

3. Remember that in applications involving mains, *switch off* before touching any of the exposed circuitry.

★



SPACEWATCH

By Frank W. Hyde

ESRO PROGRAMME

The satellite programme now finalised by the European Space Research Organisation consists of seven vehicles for the period 1969 to 1975. These are all scientific satellites. In addition to these there are several feasibility studies which will be undertaken by both the European Space Research and Technology Centre and industry through ESRO contracts.

These include a combined pure research and operational meteorological satellite for data collection and distribution. The pure research would be devoted to investigation of the lower atmosphere properties of winds and temperatures; the meteorological data would be collected and distributed in the usual way. The satellite would have a three-axis stabilisation, one pointing to the centre of the earth and another along the flight path in addition to normal. Two versions may be made, one of 225kg using *Europa I* for launch and a smaller version for *Scout* launch weighing 115kg.

The research for these projects is being undertaken by Elliot Bros. with Fokker and Dornier. The equipment will include a basic radiometer, a scanning radiometer/photometer, an ultra-violet solar monitor, and a balloon interrogation system. The solar paddles for power supply will be moveable.

ULTRA-VIOLET

The Mercury fly-past probe has already been described. An ultra-violet astronomy satellite *UVAS* may be part of the next major project. This vehicle is intended to be complementary to the NASA Orbiting Astronomical Observatories. One version is by the Culham Laboratory at Abingdon covering U-V spectroscopy and another by Fiat using U-V mapping in place of spectroscopy.

TD-I which is scheduled to be launched by a *Delta N* in 1972 weighs about 450kg. It is an astrophysics laboratory which will measure and analyse electromagnetic radion from the sun and other celestial objects. There are to be seven experiments. Four of these will scan the sky at a number of wavelengths to detect the emission of galactic and extra-galactic sources, two others will be sun pointing, and there will be a cosmic ray telescope to observe primary particles.

VACUUM TELESCOPE

At Sunspot in New Mexico a solar telescope of revolutionary design came into operation in October 1969. The telescope of the tower type was designed and built by the United States Air Force Cambridge Research Observatory at Sacremento Peak. Built at a cost of $3·2 million it is hoped that it will enable more precise measurements of solar activity and accurate forecasts of possible harmful radiations to be made. Thus astronauts' wellbeing will be safeguarded. It will also enable an assessment to be made regarding communications and allowances made for the effect on the signals to and from spacecraft at great distances.

The tower is 39 meters in height and surrounds the tube of the telescope itself. The tube of the telescope is 98 metres in length, and the upper portion rotates to follow the sun's path. The optics are simplified by this method and are also out of reach of most of the turbulence arising from the ground.

MERCURY BEARING

The tube which weighs about 250 tons is three metres across at its widest point and floats on a mercury bearing near the top of the tower. The sun's rays enter through a quartz window 76cm across and are reflected down the tower to the mirror (which is 45 metres below ground), then up to ground level to three spectroscopes. One of these is a new universal spectroscope specially to serve this telescope.

The unique feature of this telescope is the fact that the whole system is in a vacuum. The tube is kept free of air turbulence and dust by this method. In addition the tower itself is refrigerated to minimise the possible dancing of the image of the sun.

The observatory has a special interest in the study of the chromosphere of the sun. This is the highly turbulent envelope thousands of kilometres deep from which there are eruptions of plasma and the ejections of matter and radiations which affect communications.

THE DENSITY OF PLUTO

It is only now that a more accurate estimate of the density of the most distant planet known in the solar system has been made, that the orbit of Neptune can be more accurately computed. Neptune was discovered in 1846 and has only completed about three-quarters of its orbit up till now.

The theories have all been based on an assumed value for density of Pluto. These have been based on the amount of the orbit of Neptune that has been observed. The two variables which are dependent on each other for their assessment are now again the subject of study.

Hitherto the mass of Pluto has been taken to be about 0·9 that of the earth. American astronomers at the United States Naval Observatory in Washington have suggested that it would be less complicated to assess the correct values if the mass of Pluto was adjusted to what is known now of Neptune's orbit. Accordingly they suggest that mass should be taken as 0·2 as this is the value that best fits the known facts.

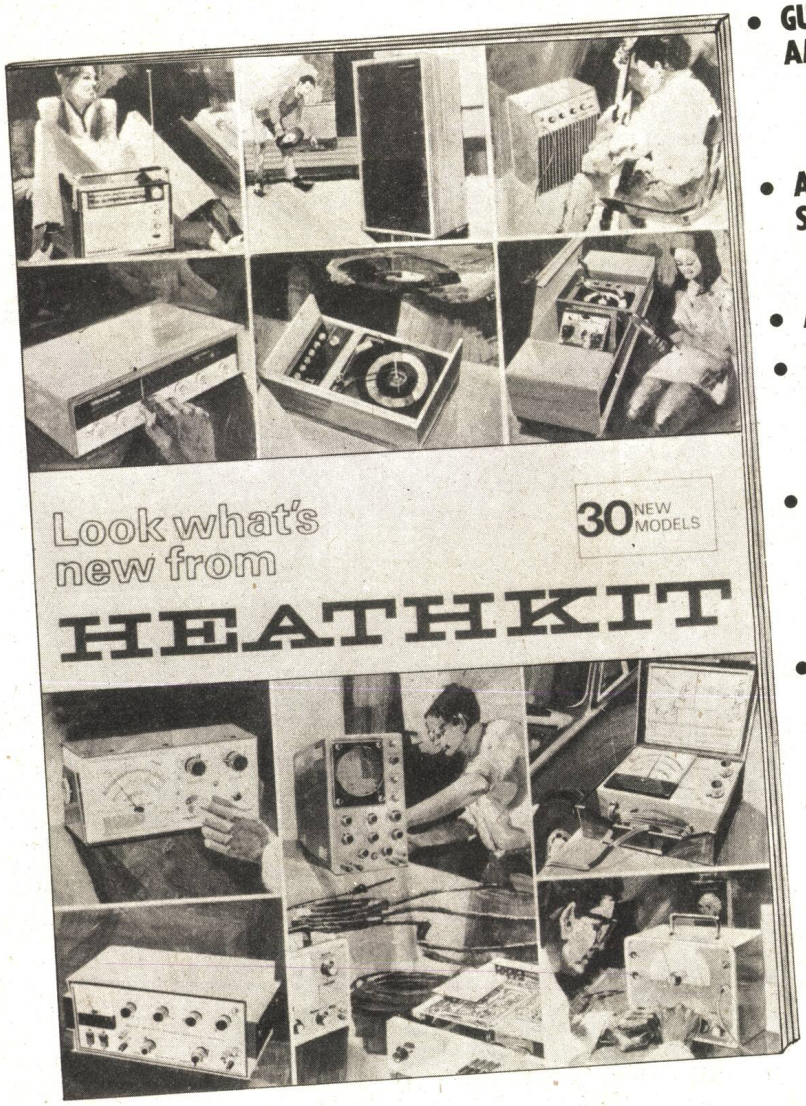
The interesting thing about this suggestion is that whereas the earlier figure for the mass implies an extremely high density, the new suggestion requires a density of only 1·5 times that of the earth. This is much more plausible. Of course the whole problem will be solved in the year 2,000 when Neptune will have completed its orbit round the sun. This however may well be after probes have been in that vicinity and sent back direct information.

MORE PULSARS

Professor J. G. Davies has announced that two more pulsars have been found. As the Mark I telescope at Jodrell Bank is undergoing some modifications, it required to be pointed to the zenith without azimuth movement for about two months. The whole of this period was taken up with the study of pulsars.

In October the two mentioned were discovered by a technique developed by Professor Davies. This technique is to look for individual dispersed pulses rather than for pulses over a period. The two frequencies used are a few MHz separation at a frequency nominally 480MHz. One advantage of the method is that it is sensitive to the many pulsars that do not show continuous trains of pulses. The two new ones found were more sporadic in their pulsations than the earlier pulsars found. At the date of the October discovery the total number of pulsars catalogued was 43.

There's Something for Everyone in the NEW HEATHKIT CATALOGUE!



- GUITAR PRACTICE AMPLIFIER
- ELECTRONIC METRONOME
- AMBASSADOR SPEAKERS
- AUTO-TUNE-UP METER
- AIRCRAFT MONITOR RECEIVER
- CAR RADIO
- TECHNICIANS LOW-COST 'VVM'
- SEVERN AM/FM RADIO
- FABULOUS STEREO HI-FI COMPACTS
- STEREO RECORD PLAYER
- D.I.Y. SPEAKER SETS
- GENERATORS
- POWER SUPPLIES
- D.I.Y. RADIOGRAM PACK
- MANY OTHER MODELS TOO NUMEROUS TO MENTION

Leisure time takes on a new sparkle, a new interest when you add the creative fun you get from building a Heathkit model. Get the thrill of personal achievement when you switch on and realise that you've done something you doubted you could ever do. Your first step is FREE! just simply send for the latest Heathkit catalogue and see what a wide choice of models we offer. What ever your requirement, be it Hi-Fi, Audio, a Portable Radio, a Record Player, Amateur Radio, a SW Receiver, a Test Instrument or Educational Equipment . . . There is something for everyone. And we are adding to our wide range continuously.

To: DAYSTROM LTD., GLOUCESTER

Please send me my free copy of the 1970 HEATHKIT CATALOGUE

NAME .....

ADDRESS .....

P.E. 1A

DAYSTROM LIMITED
Gloucester GL2 6EE England
Tel.: Glos. 29451 Telex 43216

HEATHKIT

R.S.T. VALVE MAIL ORDER CO.

BLACKWOOD HALL, WELLFIELD RD., S.W.16

SPECIAL EXPRESS MAIL ORDER SERVICE

TRANSISTORS		28003	12/-	BCY34	6/-	GET102	6/-	NKT675	6/-	OC43	9/-	DLS19	30/-	EF183	6/6
IN21	3/6	28004	11/-	BCY39	24/-	GET114	4/-	NKT676	5/-	OC44	4/-	DW4350	7/6	EF184	7/-
IN22	5/-	28005	48/-	BCY40	12/-	GET115	9/-	NKT677	5/-	OC44M	5/6	DY86	6/-	EF804	21/-
IN429	12/6	28006	20/-	BCZ11	5/-	GET116	15/-	NKT678	6/-	OC45	3/6	DY87	5/-	EFP60	10/-
IN1192	17/6	28012	80/-	BDY11	27/6	GET571	5/-	NKT713	7/6	OC45M	4/-	E88CC	12/-	EH90	7/6
IN3065	13/9	28012A	55/-	BDY12	32/-	GET872	6/-	NKT777	8/-	OC46	5/6	E180F	17/6	EL33	12/6
IS113	4/6	28013	20/-	BFY51	3/6	GET874	5/-	OA2	6/3	OC47	7/6	E182CC	22/6	EL34	10/6
IS131	4/3	28018	60/-	BFY52	4/6	GET875	6/-	OA7	4/-	OC57	16/-	EABC80	6/6	EL41	10/6
IS420R	12/6	28108	60/-	BPY10	21/6	GET880	9/-	OA10	3/-	OC58	17/6	EAF42	10/-	EL42	10/6
2152	4/3	28301	12/6	BSY27	9/6	GET885	5/-	OA47	3/-	OC59	18/6	EB91	3/-	EL81	9/-
2G210	12/6	28320	9/-	BSY28	5/-	GEX54	2/6	OA70	2/-	OC70	4/-	EBC33	8/6	EL84	4/9
2G309	5/-	28702	15/-	BSY51	7/6	GEX541	15/-	OA79	2/6	OC71	3/6	EBC41	10/6	EL85	7/9
2G381	5/-	45L	45/-	BSY53	7/6	GJ3M	3/6	OA81	2/6	OC72	5/-	EBC90	4/9	EL86	8/3
2G382	6/-	AC107	10/-	BSY95A	5/6	GJ5M	3/6	OA85	2/6	OC73	7/6	EBF80	7/6	EL90	6/3
2G401	5/-	AC126	6/6	BSX82	40/-	GJ6M	3/6	OA86	4/-	OC74	6/-	EBF83	9/-	EL95	6/6
2G402	6/-	AC127	7/6	BTY88	19/6	GJ7M	6/6	OA91	2/6	OC75	6/-	EBF89	6/6	EL360	24/-
2G403	10/6	AC128	6/6	BTY95100R		HD2967	4/-	OA200	3/3	OC76	5/-	EBL21	12/-	EL500	20/6
2G414	6/-	AC176	7/6		140/-	HG5002	4/-	OA202	4/3	OC77	8/-	EBL31	27/6	EL821	7/6
2G415	6/-	ACY17	7/6	BY100	5/6	JK9A	22/6	OA210	7/6	OC78	5/-	ECC33	15/-	EL822	16/-
2G416	6/6	ACY18	5/3	BY114	5/-	JK10A	15/-	OAZ200	11/-	OC81	5/-	ECC40	17/6	ELL80	20/-
2G417	6/-	ACY19	6/6	BYZ11	9/6	JK10B	15/-	OAZ201	10/-	OC81D	3/-	ECC81	6/-	EM34	21/-
2N247	9/6	ACY20	5/-	BYZ12	12/-	JK19A	22/6	OAZ202	8/6	OC81DM	3/-	ECC82	5/9	EM80	7/6
2N274	9/6	ACY21	6/-	BYZ13	7/6	JK21A	12/6	OAZ204	8/6	OC81M	5/6	ECC83	6/3	EM81	8/3
2N410	3/6	ACY22	3/6	BYZ18	15/-	K835A	5/-	OAZ206	8/6	OC81Z	9/-	ECC85	5/-	EM84	7/6
2N555	12/6	ACY28	4/6	CDT1313	12/6	MAT101	8/6	OAZ208	6/6	OC82	6/-	ECC88	7/6	EN32	25/-
2N585	7/6	AD140	16/-	CG64	2/6	MAT120	7/9	OAZ222	9/6	VALVES		ECF80	6/6	EY51	8/-
2N599	12/6	AD161	11/-	CK707	2/6	NKT128	6/-	OAZ224	10/-			ECF82	6/6	EY81	7/-
2N696	10/-	AF114	6/6	CR8I/05	7/6	NKT142	8/-	OAZ225	10/-	AZ31	10/-	ECH35	11/6	EY83	8/6
2N697	12/6	AF115	6/6	CV102	3/6	NKT211	6/-	OAZ242	4/6	CIC	20/-	ECH42	12/6	EY84	9/-
2N700A	6/6	AF116	6/-	CV103	3/6	NKT214	4/-	OAZ246	4/6	CY30	12/6	ECH81	5/9	EY86	7/-
2N1040	20/-	AF117	6/6	CV425	3/6	NKT216	7/6	OAZ290	9/6	DAF91	4/6	ECH83	8/6	EZ40	8/9
2N1132	19/6	AF118	10/-	CV2226	20/-	NKT217	8/-	OAZ292	9/6	DAF96	7/6	ECL80	5/9	EZ41	9/6
2N1301	19/6	AF125	6/3	CV2258	25/-	NKT218	6/-	OC16	20/-	DCC90	10/6	ECL82	7/-	EZ80	5/6
2N1304	6/6	AF178	12/6	CV2290	5/-	NKT221	5/6	OC19	7/6	DF91	4/-	ECL83	10/3	EZ81	5/6
2N1306	6/-	AF186	17/6	CV2919	2/6	NKT223	6/-	OC20	15/-	DF96	7/6	ECL86	9/-	GT1C	57/6
2N2062	7/6	AFY19	22/6	CV1782	30/-	NKT224	4/6	OC22	10/-	DH3/91	£6	ECLL800	30/-	GZ30	10/-
2N2068	20/-	AS220	7/6	CV7183	30/-	NKT225	3/6	OC23	11/6	DH77	4/9	EF9	20/-	GZ32	10/-
2N2147	12/6	ASZ21	12/6	DD003	3/6	NKT227	5/6	OC24	15/-	DK91	6/-	EF37A	7/-	GZ34	11/-
2N2160	15/0	ASZ23	30/-	DD190	9/9	NKT228	6/-	OC25	9/-	DK92	9/-	EF39	8/-	GZ37	15/-
2N2369A	4/6	ATZ10	30/-	DD226A	7/6	NKT251	5/-	OC26	7/-	DK96	7/9	EF41	12/-	H63	18/-
2N2398	30/-	AUY10	39/6	EW99	5/-	NKT265	9/6	OC28	12/-	DL66	25/-	EF80	4/3	HL41DD	13/6
2N2904	10/-	BC107	7/6	GET7	5/-	NKT274	5/-	OC29	15/-	DL92	6/3	EF86	6/6	KT61	17/6
2N2904A	12/6	BC108	5/-	GET8	8/-	NKT304	8/-	OC35	12/6	DL94	6/9	EF89	5/6	KT66	21/-
2N2926	5/3	BC109	7/6	GET16	7/3	NKT352	8/-	OC36	12/6	DL96	7/9	EF91	2/9	KT67	45/-
2N3819	13/-	BCY31	13/6	GET20	10/-	NKT404	12/6	OC41	6/-	DLS10	12/6	EF92	2/6	KT81(7C5)	
28002	20/-	BCY33	7/6	GET88	5/-	NKT452	12/6	OC42	5/-	DLS16	30/-	EF98	15/-		22/6

Postage 6d. valve, transistors post free

OPEN DAILY TO CALLERS 9 a.m.—5.30 p.m. No early closing

C.W.O. No C.O.D. Tel. 01-769 0199 & 1649

SEND S.A.E. FOR FREE LIST OF 6,000 TYPES, VALVES AND TRANSISTORS

4-STATION INTERCOM

£7/15/0

Solve your communication problems with this **4-Station Transistor Intercom** system (**1 master** and **3 Subs**), in de-luxe plastic cabinets for desk or wall mounting. Call/talk/listen from **Master** to **Subs** and **Subs** to **Master.** Ideally suitable for Business, Surgery, Schools, Hospital, Office and Home. Operates on one 9V battery. On/off switch. Volume control. Complete with 3 connecting wires each 66ft. and other accessories. P. & P. 7/6.

MAINS INTERCOM

No batteries—no wires. Just plug in the mains for instant two-way, loud and clear communication. On/off switch and volume control. Price **£10.19.6.** P. & P. 8/6 extra.

INTERCOM/BABY ALARM

3 Gns

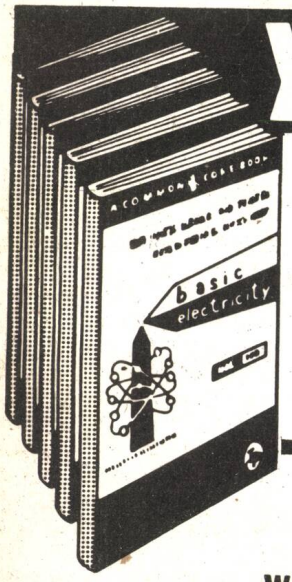
Same as 4-Station Intercom for two-way instant communication. Ideal as Baby Alarm and Door Phone. Complete with 66ft. connecting wire. Battery 2/6. P. & P. 4/6.

59/6

Why not boost business efficiency with this incredible De-Luxe **Telephone Amplifier.** Take down long telephone messages or converse without holding the handset. A useful office aid. On/off switch. Volume control. Battery 2/6 extra. P. & P. 3/6. Full price refunded if not satisfied in 7 days.

WEST LONDON DIRECT SUPPLIES (PE/3)
169 KENSINGTON HIGH STREET, LONDON, W.8

YOURS FREE FOR 7 DAYS



The 'New Picture-Book' way of learning

BASIC ELECTRICITY (5 VOLS.) ELECTRONICS (6 VOLS.)

You'll find it easy to learn with this outstandingly successful NEW PICTORIAL METHOD—the essential facts are explained in the simplest language, one at a time, and each is illustrated by an accurate, cartoon-type drawing. The books are based on the latest research into simplified learning techniques. This has proved that the PICTORIAL APPROACH to learning is the quickest and soundest way of gaining mastery over these subjects.

TO TRY IT, IS TO PROVE IT

The series will be of exceptional value in training mechanics and technicians in Electricity, Radio and Electronics.

WHAT READERS SAY

"Basic Electronics to me is a real gem but I feel I must have Basic Electricity to really do both sets justice."

R.S., Ilfracombe.

" The books are excellent value for the purchase price."

J.W.P., Malvern.

"I would like to thank you for making this splendid series of books available to the public. Full credit must go to the authors and publishers of such a vast and badly needed step forward in technical publications."

R.W.L., Havant.

A TECH-PRESS PUBLICATION

POST NOW FOR THIS OFFER !!

To The SELRAY BOOK CO., 60 HAYES HILL, HAYES, BROMLEY, KENT BR2 7HP

Please send me WITHOUT OBLIGATION TO PURCHASE, one of the above sets on 7 DAYS FREE TRIAL, I will either return set, carriage paid, in good condition within 7 days or send the following amounts. BASIC ELECTRICITY **75/-**. Cash Price or Down Payment of **20/-** followed by 3 fortnightly payments of **20-** each. BASIC ELECTRONICS **90/-**. Cash Price or Down Payment of **20/-** followed by 4 fortnightly payments of **20/-** each. This offer applies to UNITED KINGDOM ONLY. Overseas customers cash with order, prices as above.

Tick Set required (*Only one set allowed on free trial*)

BASIC ELECTRICITY ☐ **BASIC ELECTRONICS** ☐

Prices include Postage and Packing.

Signature .....

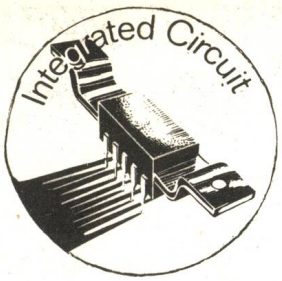
(*If under 21 signature required of parent or guardian*)

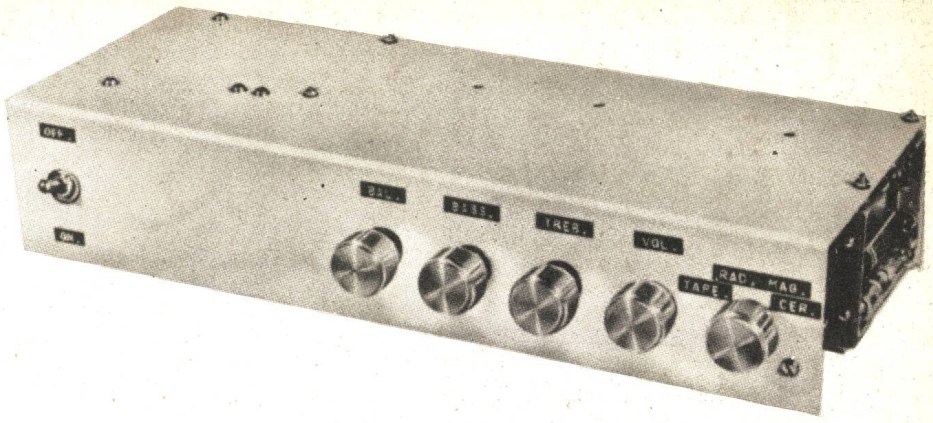
NAME .....

BLOCK LETTERS

FULL POSTAL ADDRESS .....

.....





hifi stereo amplifier

By M. J. Gay Chief Circuit Engineer (Linear), Plessey Microelectronics

LAST month we completed the description of the two main amplifiers and their construction. Now we will describe the pre-amplifier circuit used to feed the amplifiers.

PRE-AMPLIFIERS

The pre-amplifier design uses two Plessey SL702C integrated circuit operational amplifiers per channel. The first amplifier provides amplification and equalisation for the various signal sources. The second amplifier provides further amplification and tone controls. Programme sources covered are crystal or ceramic pick-up, magnetic pick-up, tape replay and radio. The circuit diagram is shown in Fig. 11.

OPERATIONAL AMPLIFIER BIASING

Operational amplifiers, having differential input stages, normally need two supply lines. In the arrangement used here the SL702C generates its own "earth" reference at half supply voltage by means of decoupled d.c. feedback from the normal earth point. Fig. 10 shows the circuit diagram of the SL702C plus biasing arrangements. The amplifiers are operated on a 12V supply.

EQUALISATION SECTION

For radio, tape and magnetic pick-up inputs the amplifier is used with series feedback but for crystal or ceramic pick-up inputs it is used with capacitive shunt feedback. The feedback network is selected by switch S1c and the appropriate input to the integrated circuit by switches S1a and S1b. The "tape" feedback network consists of R11 and C11. Resistor R11 must be chosen to suit the playback speeds as in Table 2. Magnetic pick-up compensation is obtained from the network R10, C9 and C10; C11 provides shunt feedback for use with ceramic pick-ups. For radio inputs the amplifier gain is reduced to just over unity.

Table 2. TAPE EQUALISATION

Speed (inches per second)	R11
3·75	22kΩ
7·5	10kΩ
15	6·8kΩ

The use of capacitive shunt feedback when the amplifier is fed from a ceramic pick-up obviates the requirement for a very high input impedance. The pick-up capacitance and the feedback capacitor act as a see-saw about the amplifier's virtual earth input giving a constant gain down to very low frequencies. Furthermore the amplifier can readily handle the possibly very high outputs from ceramic or crystal pick-ups, when connected in this manner. With a 6·8nF feedback capacitor (C11) the amplifier output will be typically seven times lower than the pick-up output. This brings the output near that obtained with other programme sources and ensures that good overload capability is maintained.

RUMBLE FILTER

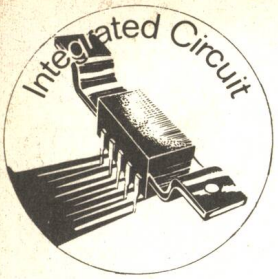
A simple rumble filter is incorporated in the equalisation circuit by the inclusion of the network R7, R8, R9 and C7 across the feedback components. At low frequencies as C7 impedance rises, the transfer impedance of this network falls causing the amplifier gain to fall (R8 damps the bridged T network resonance between R7, R9, C7 and C11 or C9 plus C10). With radio inputs, when the amplifier gain is set to a much lower level, the rumble filter is inoperative.

With radio, tape and magnetic pick-up inputs the input impedance of the amplifier is set at 47 kilohms by R3. A small (47pF) capacitor (C3) is added to reduce the possibility of h.f. oscillation due to stray capacitance feedback into this impedance when the input is open circuit.

The operational amplifier is stabilised by capacitors C4 and C5 connected to its two compensation points.

TONE CONTROL SECTION

The main amplifier requires a low impedance drive to avoid upsetting the active filter characteristics. Therefore it is not possible to place an attenuator type tone control after the pre-amplifier. Noise considerations make it equally undesirable to place one after the equalisation stage. The tone controls are therefore incorporated into a feedback network around the second operational amplifier. The "Baxandall" arrangement is used since this has the considerable advantage of using linear potentiometers (other



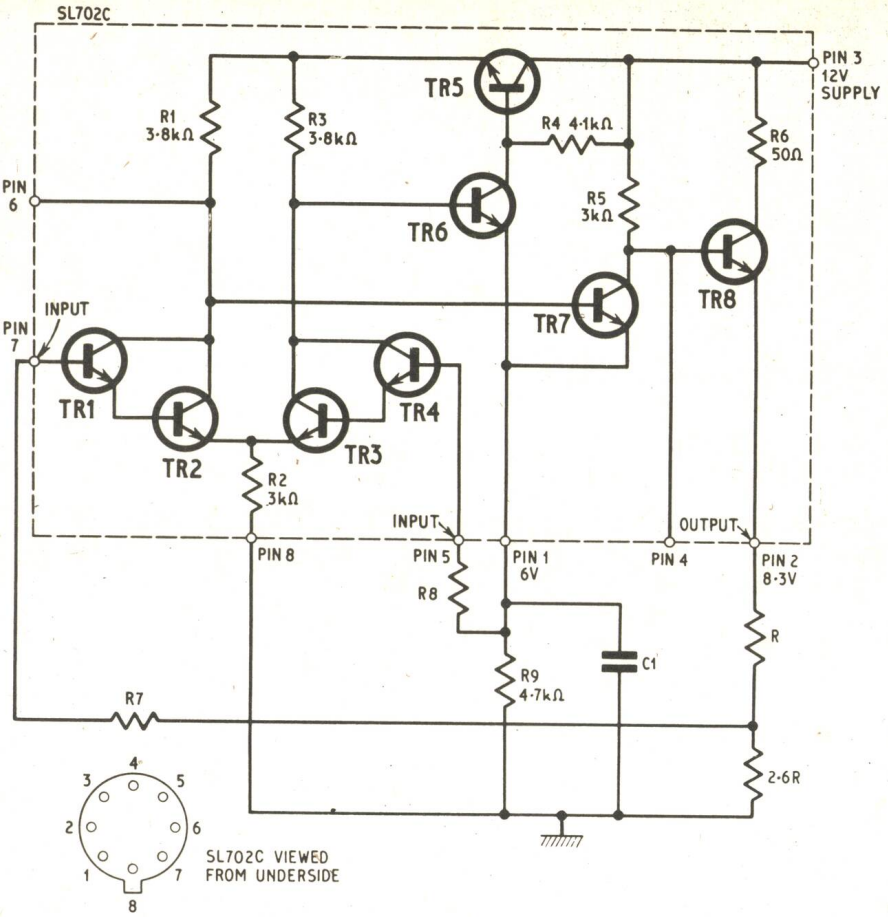


Fig. 10. Biasing arrangements for the SL702C integrated circuit—voltages are nominal values

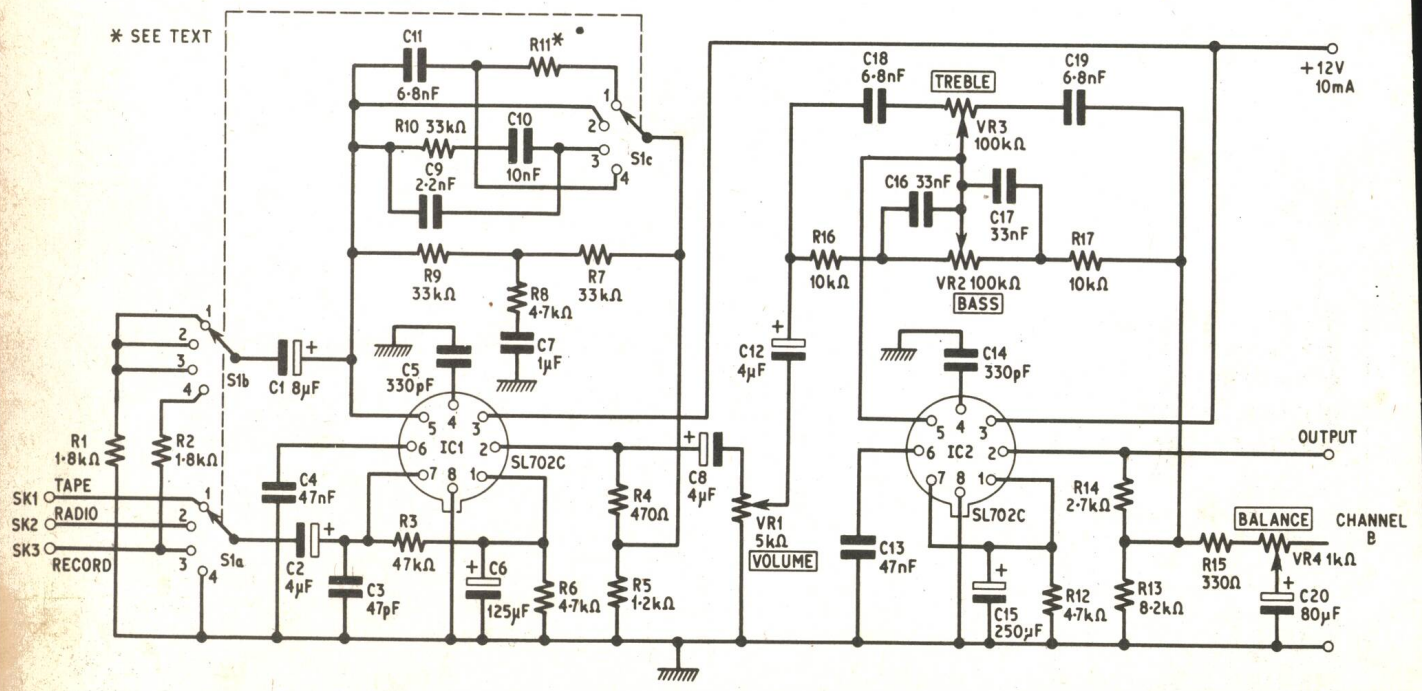


Fig. 11. Circuit diagram and one channel of the pre-amplifier section of the hi fi stereo amplifier. S1 positions are: 1 Tape, 2 Radio, 3 Magnetic pick-up, 4 Ceramic pick-up

LOOK!

PRACTICAL!
VISUAL!
EXCITING!

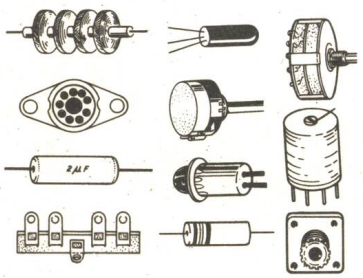
a new 4-way method of mastering

ELECTRONICS

by ***doing*** *—* ***and*** *—* ***seeing*** *. . .*

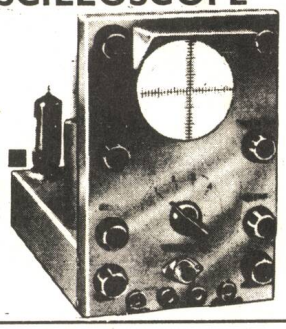
1 **OWN and HANDLE a**

complete range of present-day **ELECTRONIC PARTS** and **COMPONENTS**

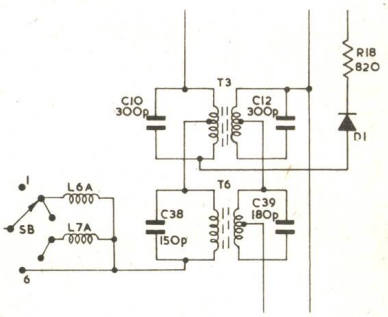


2 **BUILD and USE**

a modern and professional **CATHODE RAY OSCILLOSCOPE**



3 **READ and DRAW and UNDERSTAND CIRCUIT DIAGRAMS**



4 **CARRY OUT OVER 40 EXPERIMENTS ON BASIC ELECTRONIC CIRCUITS AND SEE HOW THEY WORK . . . INCLUDING . . .**

- VALVE EXPERIMENTS
- TRANSISTOR EXPERIMENTS
- AMPLIFIERS
- OSCILLATORS
- SIGNAL TRACER
- PHOTO ELECTRIC CIRCUIT
- COMPUTER CIRCUIT
- BASIC RADIO RECEIVER
- ELECTRONIC SWITCH
- SIMPLE TRANSMITTER
- A.C. EXPERIMENTS
- D.C. EXPERIMENTS
- SIMPLE COUNTER
- TIME DELAY CIRCUIT
- SERVICING PROCEDURES

This new style course will enable anyone to really understand electronics by a modern, practical and visual method—no maths, and a minimum of theory—no previous knowledge required. It will also enable anyone to understand how to test, service and maintain all types of Electronic equipment, Radio and TV receivers, etc.

FREE POST NOW for BROCHURE

or write if you prefer not to cut page

To: BRITISH NATIONAL RADIO SCHOOL, READING, BERKS. Please send your free Brochure, without obligation, to: *we do not employ representatives*

NAME..... BLOCK CAPS

ADDRESS..... PLEASE P.E.1

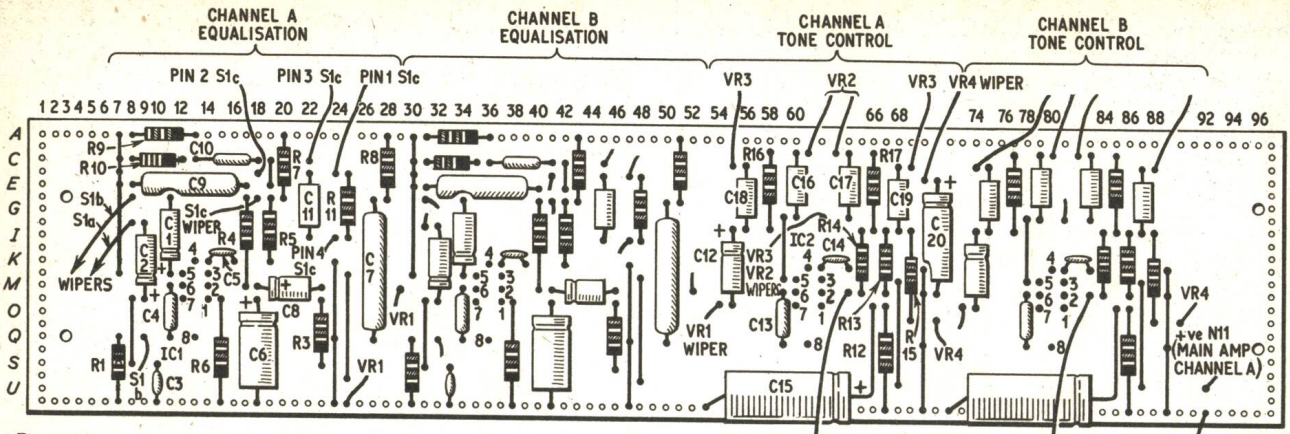
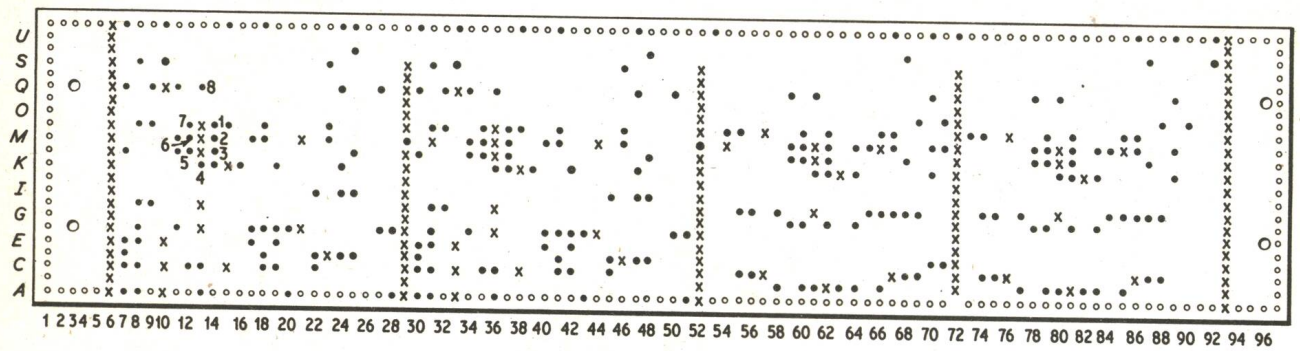


Fig. 12. Veroboard layout and wiring of both pre-amplifiers. Component numbers and wiring connections have been shown for channel "A" only; channel "B" is wired up in the same way. IC1 and 2 connections are indicated by numbers 1 to 8 on the board



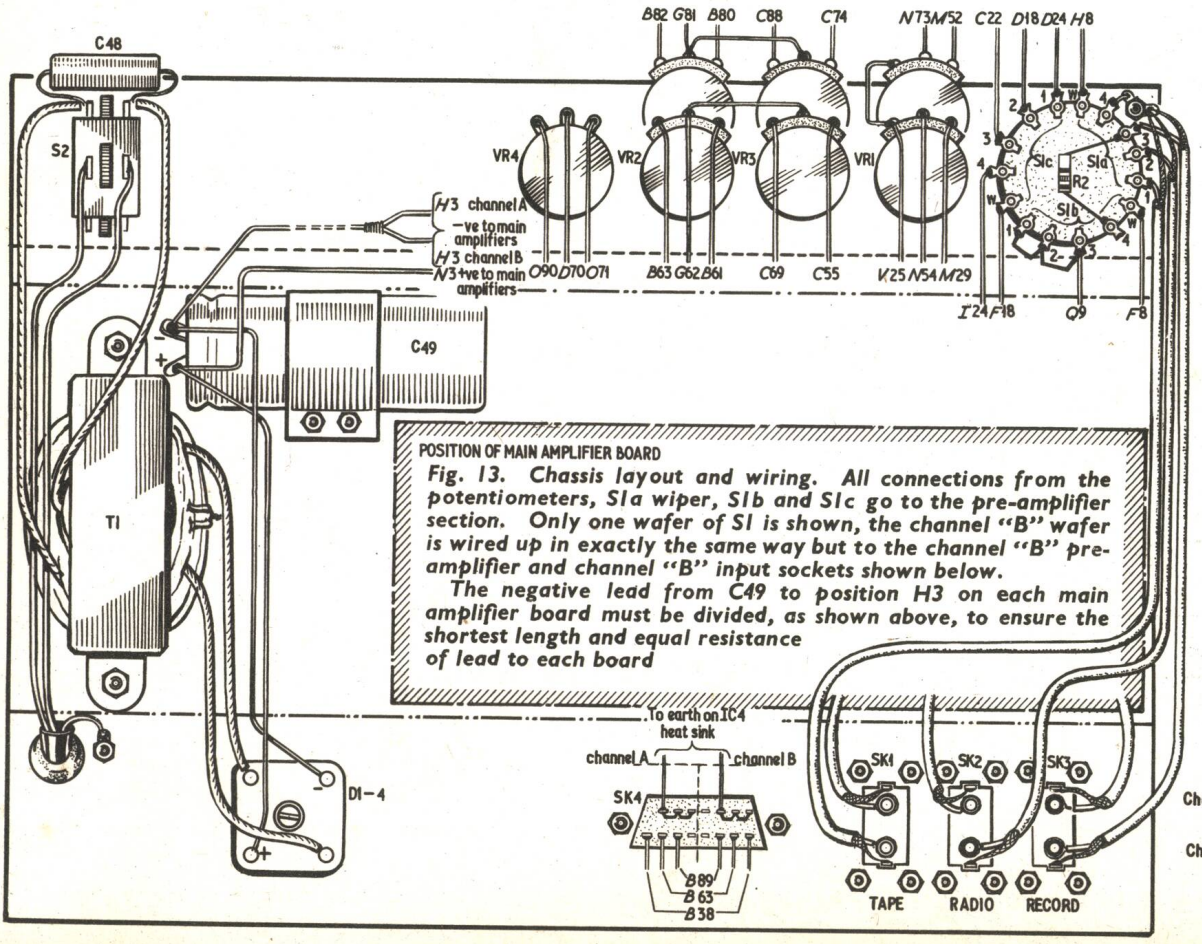


Fig. 13. Chassis layout and wiring. All connections from the potentiometers, S1a wiper, S1b and S1c go to the pre-amplifier section. Only one wafer of S1 is shown, the channel "B" wafer is wired up in exactly the same way but to the channel "B" pre-amplifier and channel "B" input sockets shown below.

The negative lead from C49 to position H3 on each main amplifier board must be divided, as shown above, to ensure the shortest length and equal resistance of lead to each board

arrangements require antilogarithmic potentiometers). The standard Baxandall see-saw gives a mid-band gain of unity which is too low for our requirements. An attenuator is therefore placed between the amplifier output and the feedback network to increase the overall mid-band gain to approximately five times.

The attenuation is varied by means of the potentiometer VR4 (Fig. 11) which provides the balance adjustment, and is connected between the two channels. This control gives a gain adjustment range of −3dB to +6dB for each channel and thus compensates for balance errors up to 9dB. The operational amplifier is stabilised by capacitors C13 and C14.

PRE-AMPLIFIER CONSTRUCTION

The two pre-amplifiers were built on a 0·1in. matrix Veroboard shown in Fig. 12. Because the potentiometers used had bushes too short to enable the controls to be affixed to the Veroboard and a chassis, they were attached by floating leads. The constructional points made previously in this article should also be considered when building the pre-amplifier section.

The crosses shown on the underside of the Veroboard represent breaks in the copper strip and should be made before affixing the components; this also applies to Fig. 5 last month.

MECHANICAL CONSTRUCTION

The main amplifier boards and pre-amplifier board have been bracketed together as shown in Fig. 14. The assembly is mounted in a simple chassis which carries the controls and power supply components (Fig. 13). To allow adjustment of the speaker sensitivity balancing potentiometers, access holes are drilled in the chassis, Fig. 15.

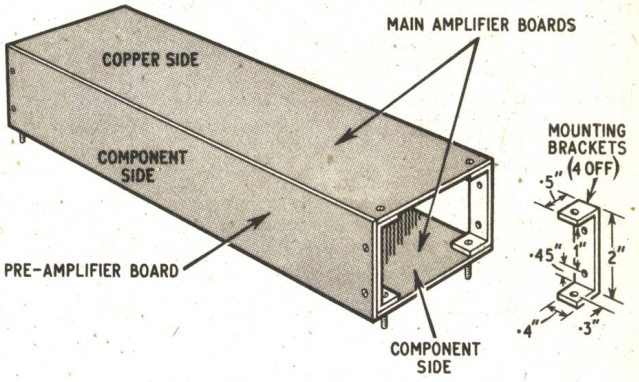


Fig. 14. Circuit board assembly details

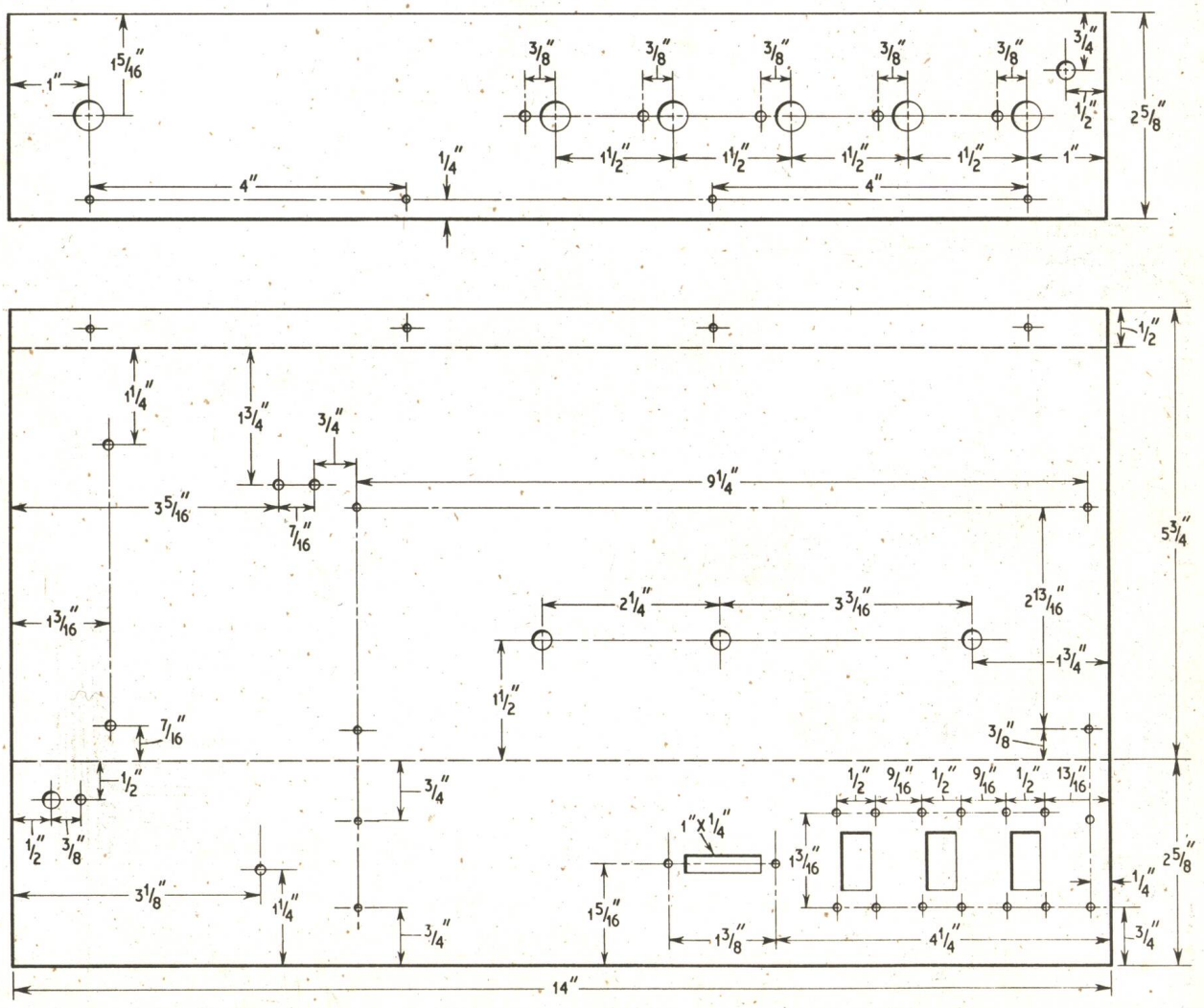
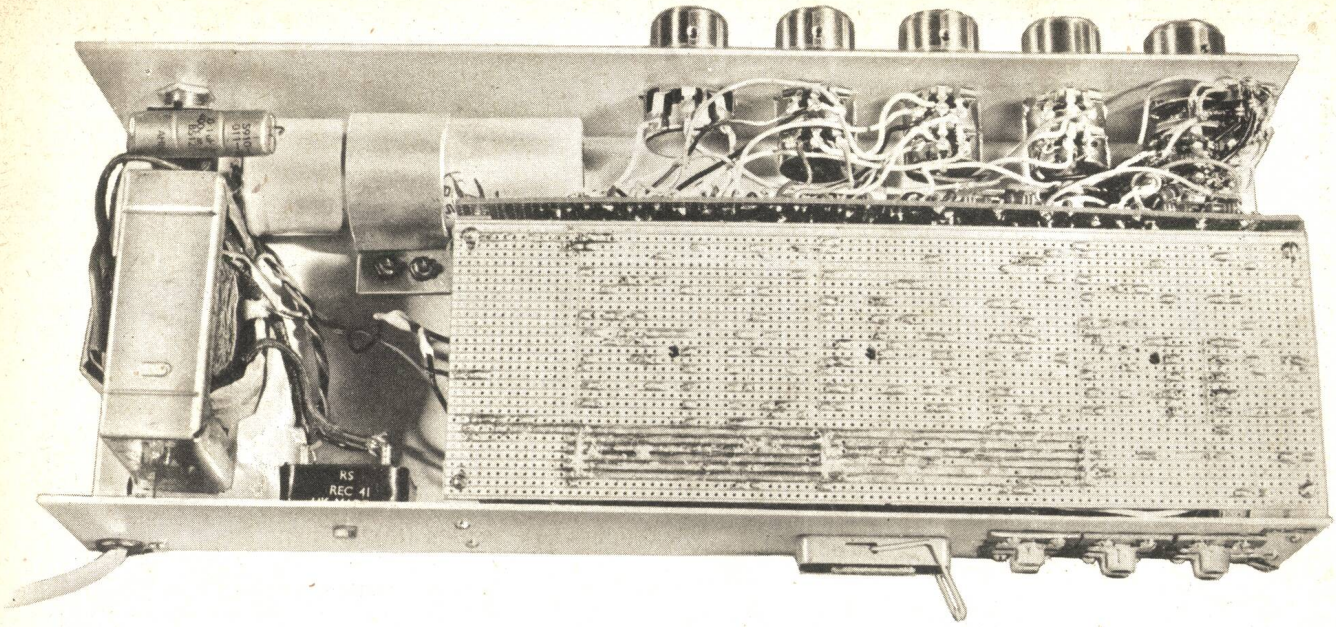


Fig. 15. Chassis details for the hi fi stereo amplifier. The front panel has been made removeable to enable wiring to the controls



Underside view of the completed amplifier ready for use

PRE-AMPLIFIER PERFORMANCE

The response curves for the equalisation section are shown in Fig. 16. Fig. 17 shows the tone control characteristics. The sensitivities at the different settings are given in Table 3 (these are inputs required for 300mV r.m.s. output with volume control at maximum.)

Table 3. INPUT SENSITIVITIES

Input	Radio	Ceramic p.u.	Magnetic p.u.	Tape (3·75in per sec)
Sensitivity	35mV r.m.s.	400mV r.m.s.	2·5mV r.m.s. at 1kHz	2·5mV r.m.s. at 1kHz

The amplifier input impedance allows operation from tape heads of up to one Henry inductance. Typically half track heads of 100mH generate around 2·5mV at 1kHz. If lower output heads are used then higher gain will be required. Referring to Fig. 11 this may be obtained by reducing R15 and VR4 (halving their value doubles the gain). To maintain the l.f. response C15 and C20 must be proportionately increased. The other sensitivities are more than adequate; that quoted for ceramic p.u. is for units of 800pF capacitance. The overload margin of the equalisation section is 30dB at all settings.

DISTORTION

Distortion was measured for the equalisation section at 60mV r.m.s. output (corresponding to full drive into the main amplifier) and at 600mV r.m.s. output, and for the tone control section at 300mV r.m.s. output (full drive into the main amplifier). Since the SL702C is an essentially linear amplifier and we have up to 40dB negative feedback around it, we expect very low distortion; this is the case. The equalisation section generates less than 0·01 per cent distortion (even at

COMPONENTS. . .

PRE-AMPLIFIER and CHASSIS

All components except the potentiometers, C20, S1 and Veroboard must be duplicated for channel B

Resistors

R1	1·8kΩ carbon
R2	1·8kΩ carbon
R3	47kΩ film
R4	470Ω film
R5	1·2kΩ film
R6	4·7kΩ carbon
R7	33kΩ film
R8	4·7kΩ carbon
R9	33kΩ film
R10	33kΩ carbon
R11	see text, film
R12	4·7kΩ carbon
R13	8·2kΩ film
R14	2·7kΩ film
R15	330Ω carbon
R16	10kΩ film
R17	10kΩ film

All ±10%, $\frac{1}{8}$ or $\frac{1}{4}$ watt.

Capacitors

C1	8μF elect. 16V
C2	4μF elect. 16V
C3	47pF silver mica
C4	47nF polyester
C5	330pF ceramic
C6	125μF elect. 16V
C7	1μF polyester
C8	4μF elect. 16V
C9	2·2nF polystyrene
C10	10nF polyester
C11	6·8nF polyester
C12	4μF elect. 16V
C13	47nF polyester
C14	330pF ceramic
C15	250μF elect. 16V
C16	33nF polyester
C17	33nF polyester
C18	6·8nF polyester
C19	6·8nF polyester
C20	80μF elect. 16V

Potentiometers

VR1	5kΩ tandem log
VR2	100kΩ tandem lin
VR3	100kΩ tandem lin
VR4	1kΩ lin

Integrated circuits

IC1 and IC2 SL702C Plessey (2 off)
(available from S.D.S. Ltd., Hillsea Industrial Estate, Portsmouth)

Miscellaneous

S1 6-pole 4-way wafer switch
Veroboard 0·1 inch matrix 9·8in × 2·3in
SK1, 2 and 3 double phono sockets (3 off)
16 s.w.g. aluminium 14½in × 12in

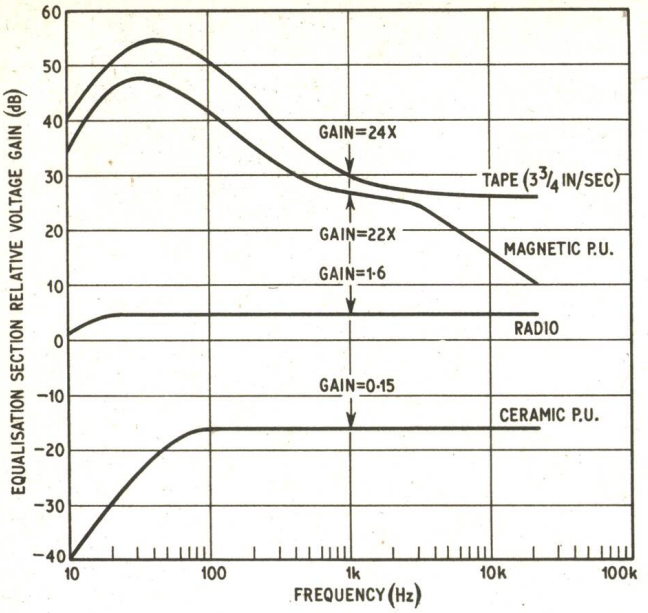
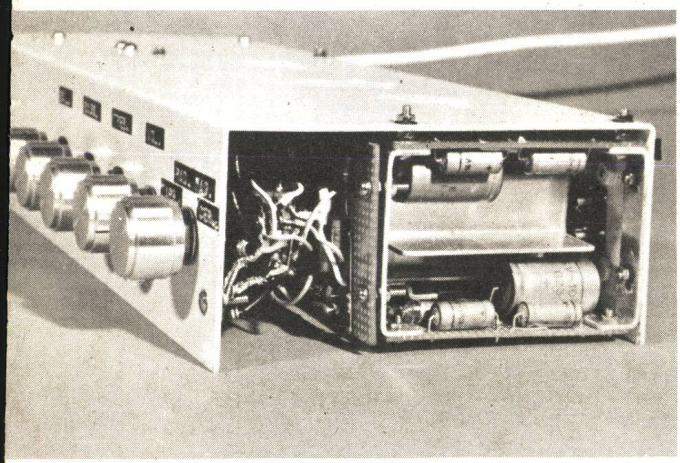


Fig. 16. Input equalisation characteristics of the pre-amplifier. These correspond to RIAA (BS 1928) characteristics



This shows the method of assembling the three component boards inside the chassis. The upper main amplifier board is separated from the chassis by four small spacers

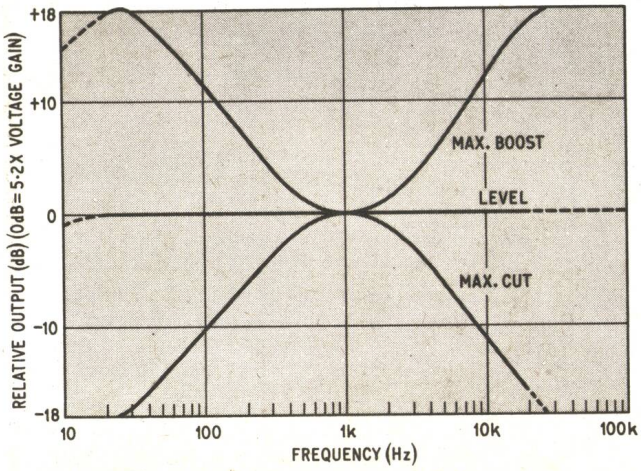


Fig. 17. Tone control characteristics

600mV r.m.s. output) except at very low frequencies in the "magnetic pick-up" and "tape" positions where the feedback is much reduced. At 40Hz for these settings, distortion reaches 0·1 per cent at 600mV r.m.s. output. With tone controls level the tone control section generates less than 0·02 per cent distortion at 300mV r.m.s. output.

NOISE

Noise measurement presents some problems as the noise spectrum is of course shaped according to the equalisation characteristics. For this reason a perceived signal to noise ratio was determined in this case. This is obtained by measuring the noise over the audio frequency band, then weighting the results according to the ear's sensitivity, before integrating to obtain the total effective noise power. Noise was measured with a 10 kilohm source for "radio", an 800pF source for "ceramic p.u." and a 110mH source for "magnetic p.u." and "tape"; these corresponding to real conditions. The results are shown in Table 4.

Table 4. NOISE LEVELS

Input	Radio	Ceramic p.u.	Magnetic p.u.	Tape
Perceived Noise	−83dB	−85dB	−64dB	−62dB
Reference Input	35mV	400mV	2·5mV	2·5mV

The noise levels shown in Table 4 are relative to the reference levels given which are the minimum required for 300mV r.m.s. output (full drive to main amplifier). In most cases, the source output will be substantially larger than these levels, particularly in the case of magnetic pick-ups which typically give 20mV r.m.s. peak music output (the high sensitivity is a by-product of the compensation required). In practice perceived noise levels will be around −90dB for radio and ceramic p.u. inputs, around −80dB for magnetic p.u. input and around −60dB for tape input.

SETTING UP

Caution: the wipers of the speaker sensitivity balancing potentiometers connect to the SL403 main amplifier input and must not be shorted to earth; use only a non-metallic tool for adjustment.

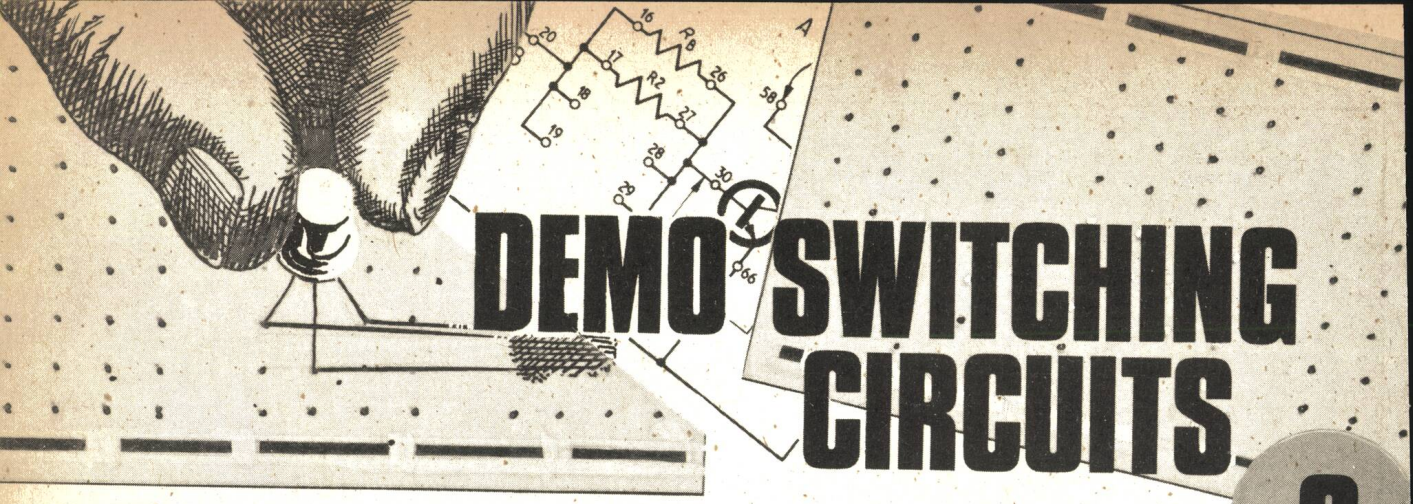
To gain access for adjustment of the bias correction potentiometers, the lower main amplifier board is freed from the assembly; this is a once only adjustment. Again take care not to short the potentiometer wipers to earth.

Listening tests are very satisfactory; the performance of the equipment was found to be significantly better than the author's valve based high fidelity amplifier (a 0·1 per cent distortion 10W system) which it now replaces. ★

Note: In the first part of this article the value of R21 was incorrectly given as 22kΩ, this should have been 12kΩ. Socket SK4 is not duplicated and R1, in Table 1, for the middle channel (250Hz crossover) should be 39kΩ.

Also the equation referring to Fig. 1b should have read:

$$\frac{V_o}{V_i} = \frac{-C_1}{C_3}\left[\frac{1}{1+\frac{1}{j\omega}\left(\frac{C_1+C_2+C_3}{C_1 C_3 R_2}\right)-\frac{1}{\omega^2}\left(\frac{1}{C_2 C_3 R_1 R_2}\right)}\right]$$



DEMO SWITCHING CIRCUITS

2

SCHMITT TRIGGER

By B. Pounder

THE Schmitt trigger is an important circuit that appears frequently in electronic switching systems. The basic circuit (Fig. 2.1) consists of a two-stage directly coupled "amplifier" with positive feedback across the common emitter resistor R3.

To see how it works, consider first that the base of TR1 is connected to the common negative line so that TR1 is non-conducting. TR2 conducts, its base current being supplied by means of the potential divider network R1, R2, and R4. The voltage dropped across R3 by the emitter current of TR2 causes the emitter of TR1 to be positive with respect to the common line. The base-emitter junction of TR1 is therefore reverse biased, so TR1 is held off.

Now if the base voltage of TR1 is gradually raised from its initial value of zero, a stage will be reached at which its value is just greater than the emitter voltage. TR1 will then begin to conduct, and as it does so, the increasing voltage drop across R1 will cause the collector voltage of TR1 to fall. The collector of TR1 is connected to the base of TR2 via a voltage divider network, therefore the base voltage on TR2 will drop and TR2 will conduct less heavily.

When the collector current of TR2 begins to fall, the voltage on the emitter falls (emitter follower action) increasing the potential difference between the base and emitter of TR1. Therefore, TR1 conducts while TR2 current is reduced to cut-off.

REGENERATIVE ACTION

The circuit can be made regenerative; that is, it will react to an initial change (the increase in V_{b1} beyond the threshold value in this case) in such a way as to increase continuously the effects of that change. The process stops when no further change is possible; in this circuit, when TR1 is hard on and TR2 is off.

The reverse situation is also true. If V_{b1} is lowered from a value in excess of the threshold, a second threshold will be reached at which the circuit will revert to its initial condition. These two switching processes are exceedingly fast.

The property of the Schmitt trigger to react very rapidly to values of V_{b1} equal to two threshold values suggests two obvious applications:

(a) as a threshold sensitive switch or "level detector";
(b) as a shaping circuit to "square-off" an input voltage waveform of arbitrary shape.

These two applications are evident from an examination of typical input and output waveforms (Fig. 2.2.)

DESIGN CALCULATIONS

The Schmitt circuit design procedure is by no means as simple as it may appear at first sight and a full algebraic derivation of formulae from which design can be carried out is quite complex. However, it is possible to make some simplifying approximations from which useful results can be obtained.

Let us use the formulae to design a circuit which will provide a 6V swing across R5 on switching and a current of 10mA in TR2 when it is conducting. Let $V_1 = 4$ volts and $V_2 = 3$ volts (Fig. 2.2). (step 1)

$$R_5 = 6 \times \frac{1{,}000}{10} = 600 \text{ ohms} \qquad \text{(step 2)}$$

(A preferred value resistor of 560 ohms can be used.)

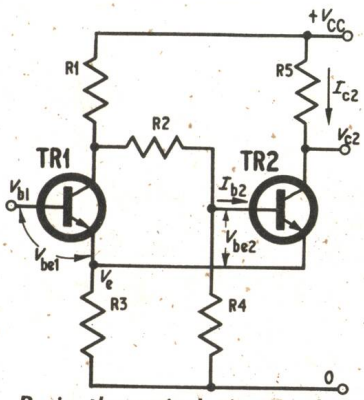


Fig. 2.1. Basic theoretical circuit of the Schmitt trigger

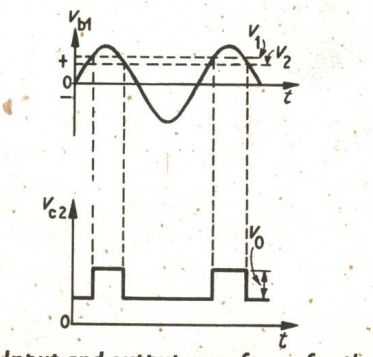


Fig. 2.2 Input and output waveforms for the Schmitt trigger showing the trigger voltages V_1 and V_2

DESIGN STEPS

1. Decide upon values of the upper and lower thresholds V_1 and V_2 respectively, the output voltage swing V_o and the collector current I_{c2} of TR2.
2. Calculate $R_5 = V_o/I_{c2}$
3. Choose a value for V_{CC}. (This must be greater than V_o.)
4. Calculate $R_1 + R_2 + R_4 = h_{FE}V_{CC}/10 \times I_{c2}$.
5. Calculate $R_4 = h_{FE}V_1/10 \times I_{c2}$. ($V_1$ is higher threshold.)
6. Calculate $R_3 = (V_1 - V_{be2})/I_{c2}$.
7. Calculate $I_{c1} = (V_2 - V_{be1})/R_3$. ($V_2$ is lower threshold.)
8. Calculate $R_1 = V_{CC}\left(1 - \frac{V_2}{V_1}\right)\Big/ I_{c1}$.
9. Calculate $R_2 = (R_1 + R_2 + R_4) - (R_1 + R_4)$.
10. Check that $h_{FE}R_3 > R_4(R_1 + R_2)/(R_1 + R_2 + R_4)$.

Let $V_{CC} = 9$V (step 3); this will be sufficient to supply an output voltage (V_o) of 6 volts and allow for a voltage drop across R3 which will be calculated later.

$$R_1 + R_2 + R_4 = h_{FE}V_{CC}/10 \times I_{c2}$$
$$= 20 \times 9/10 \times \frac{10}{1{,}000}$$
$$= 1{,}800 \text{ ohms} \qquad \text{(step 4)}$$

assuming a worst case value for h_{FE} of 20.

$$R_4 = h_{FE}V_1/10 \times I_{c2}$$
$$= 20 \times 4/10 \times \frac{10}{1{,}000}$$
$$= 800 \text{ ohms} \qquad \text{(step 5)}$$

(A preferred value resistor of 820 ohms can be used.)

$$R_3 = (V_1 - V_{be2})/I_{c2}$$
$$= (4 - 0{\cdot}6)\Big/ \frac{10}{1{,}000}$$
$$= 340 \text{ ohms} \qquad \text{(step 6)}$$

(A preferred value resistor of 330 ohms can be used.)

The value of $V_{be2} = 0{\cdot}6$ is based on the use of a silicon transistor for TR2.

$$I_{c1} = (V_2 - V_{be1})/R_3$$
$$= (3 - 0{\cdot}8)/330$$
$$= 6{\cdot}67\text{mA} \qquad \text{(step 7)}$$

$$R_1 = V_{CC}\left(1 - \frac{V_2}{V_1}\right)\Big/ I_{c1}$$
$$= 9(1 - \tfrac{3}{4})\Big/ \frac{6{\cdot}67}{1{,}000}$$
$$= 337{\cdot}5 \text{ ohms} \qquad \text{(step 8)}$$

(A preferred value resistor of 330 ohms can be used.)

$$R_2 = (R_1 + R_2 + R_4) - (R_1 + R_4)$$
$$= 1{,}800 - (340 + 800)$$
$$= 660 \text{ ohms} \qquad \text{(step 9)}$$

(A preferred value resistor of 680 ohms can be used.)

The condition of step 10 (i.e. $h_{FE}R_3$) is fulfilled.

ASSEMBLY AND OBSERVATIONS

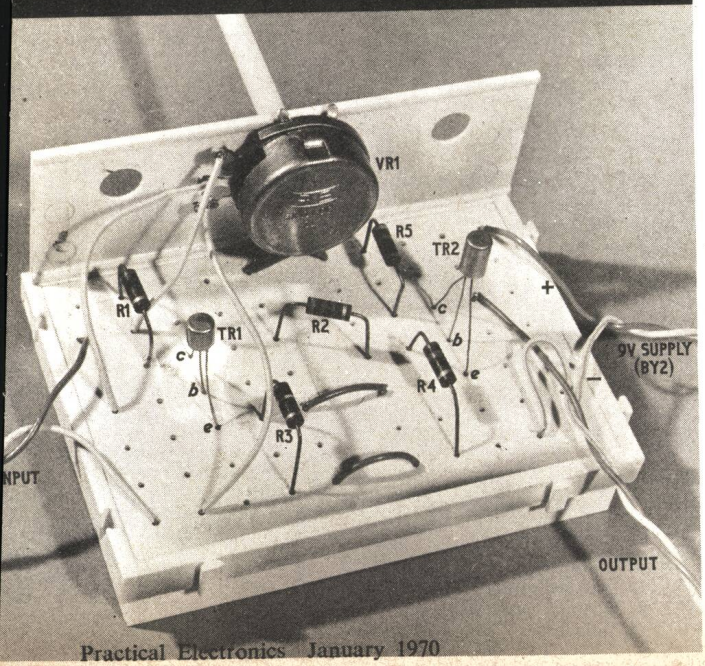
The circuit can be assembled on S-Dec using the connections shown in Fig. 2.3; the switching operation can be observed with the aid of voltmeters. Note that unless the voltmeters have high resistances, their presence will affect the d.c. conditions of the circuit.

Several transistor types can be used; those suggested are the silicon *npn* 2N706 or ZTX300. The numbering in Fig. 2.3 applies for *npn* transistors with a lead sequence e-b-c. Devices such as the TIS50 or 2N2926 which have a b-c-e sequence may need a slightly different lay-out if the wires are not to be bent across each other.

Dynamic operation of the circuit can be observed if a signal generator is used to provide the input signal, while the output voltage waveform is observed on an oscilloscope. A 6V mains transformer could be used to provide the input if required.

When applying a sinusoidal input, it is easy to cause reverse bias breakdown of the base-emitter junction of a silicon transistor. Just a few volts will often suffice.

Schmitt Trigger



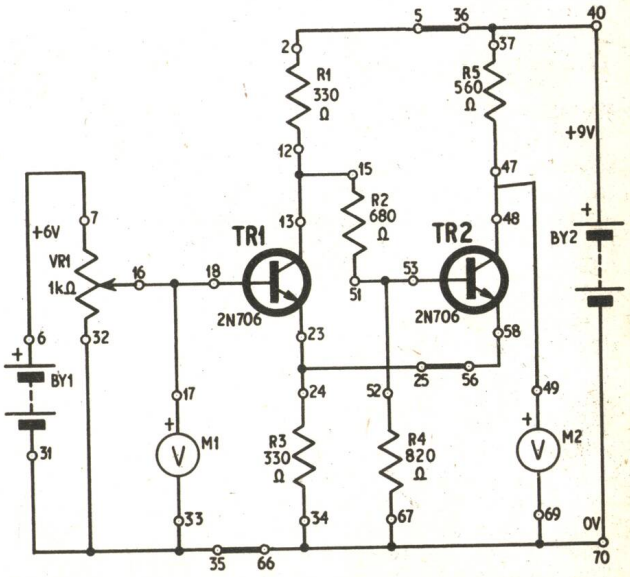


Fig. 2.3. Schmitt trigger circuit with S-Dec hole numbers for npn transistors and other components

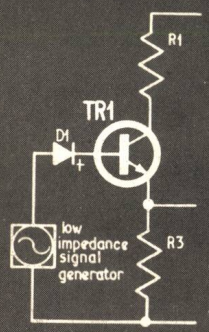


Fig. 2.4. Diode protection against base-emitter breakdown

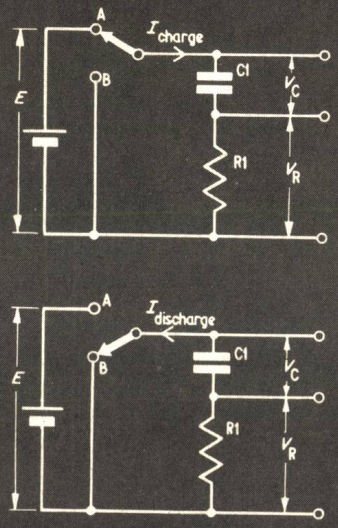


Fig. 2.5. Simple CR circuit with d.c. drive and switching for square wave. The waveforms are shown in Fig. 2.6

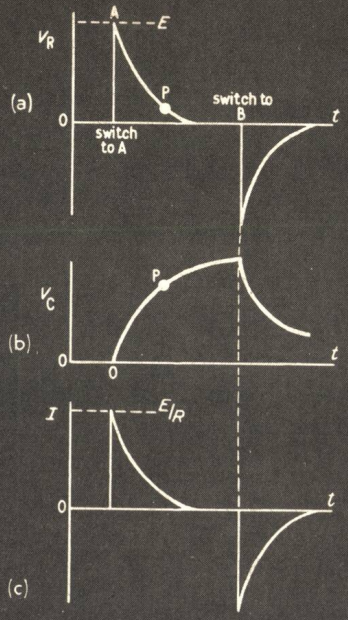


Fig. 2.6. Charging voltage across the resistor and capacitor is divided as shown above in (a) and (b). The current waveform is proportional to the voltage waveform in the resistor and is shown in (c)

To safeguard against this breakdown, a safety diode should be connected in the input lead as shown in Fig. 2.4. Any small diode will be suitable.

The effect of the difference between the thresholds V_1 and V_2 is easy to observe if the output is connected to an oscilloscope.

CR CIRCUIT TRANSIENTS

Series CR circuits are frequently used to perform timing functions in switching circuits and are also to be found in the couplings between individual switching circuits. It is important to understand how they react to rectangular voltage waveforms.

A simple circuit for obtaining a close approximation to a rectangular voltage waveform is shown in Fig. 2.5. If the switch can be made to operate alternately between positions A and B, the voltage applied to the series combination of C1 and R1 has alternate values of E and zero volts.

When the switch is at A, C1 and R1 share the total voltage E supplied from the battery. Thus $E = V_C + V_R$. The battery charges capacitor C1 through resistor R1. As the capacitor becomes fully charged, the charging voltage reduces to near zero.

The initial value of the charging current is approximately E/R_1 from Ohm's Law, but reduces as the voltage charge on the capacitor opposes the applied voltage.

Now the voltage across R1 (V_R) is always equal to $I \times R_1$ from Ohm's Law. Hence V_R has an initial value equal to E and a final value of zero some time after switching to A. It is easily shown that the relation between V_R and time t is

$$V_R = E.e^{-t/CR}$$

This is illustrated by the section of the curve marked AP in Fig. 2.6.

Now because V_R and V_C must always add up to E, the capacitor voltage V_C must be as shown. Its equation is

$$V_C = E - V_R = E(1 - e^{-t/CR})$$

If the switch connection is made to B when C1 has become fully charged, C1 will discharge through R1, the current now flowing in the reverse direction.

As more and more energy is dissipated in R1, the current (and therefore V_R) falls. V_R and V_C are now as shown on the sections of the curves beyond the point P, and are given mathematically by

$$V_R = -Ee^{-t/CR}$$
$$V_C = +Ee^{-t/CR}$$

The quantity CR, which appears in these formulae, is called the time constant of the circuit. Its significance is found by considering what happens after a time equal to CR has elapsed after switching to either A or B. Substitution of $t = CR$ in the above formulae shows that 66 per cent of the total possible voltage changes occur during this time. Thus on first switching to A, the capacitor can be considered to be almost completely charged after a time interval equal to the time constant.

Note that if CR is required in seconds, R must be in ohms and C in farads. Alternatively, R can be in megohms if C is in microfarads; for example,

if $C = 1\mu F$, $R = 1M\Omega$, $CR = 1$ sec.

if $C = 0{\cdot}001\mu F$, $R = 10k\Omega$, $CR = 10\mu sec$.

EXPERIMENTS

1. To demonstrate the above results using simple equipment it is easier to use a circuit with a long time constant. The resistance R will therefore be large, so it will be difficult to observe V_R using a moving coil voltmeter, the relatively low resistance of which will shunt R. The value of C will also be large.

If the voltmeter is connected across the capacitor to measure V_C, the meter resistance and R together form a voltage divider across E so the circuit is altered sig-

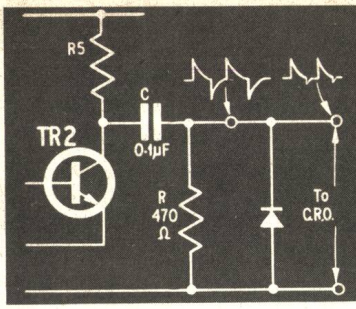


Fig. 2.7. The CR network applied to the output of the Schmitt trigger changes the square wave to a pulse waveform across the resistor. The diode will effectively reduce the negative-going spikes

nificantly. However, if a high resistance (say 20,000Ω per volt) voltmeter is available, it will be possible to demonstrate the voltages V_C and V_R if C is equal to 100μF, and R is equal to about 10 kilohms.

Note that the damping factor of the meter movement will mask a large part of the instantaneous changes indicated on Fig. 2.6. The meter should also be able to measure current to demonstrate the current–time relationship, if it is connected in series with the C and R. The circuit shown in Fig. 2.5 is easily assembled on an S-Dec "breadboard", a jumper lead being used in place of the switch.

2. The Schmitt circuit can be used as a source of a rectangular voltage waveform which can be applied to the CR circuit; the voltages V_C and V_R can be observed on an oscilloscope. A sine wave signal generator is required for the input to the Schmitt.

Apply a 1kHz signal to the Schmitt, of sufficient amplitude to cause the circuit to trigger, and observe the output voltage waveform on an oscilloscope. Now note the effect of connecting the CR circuit across the output as shown in Fig. 2.7. The time constant of this network is short, about 0·05ms, so a series of positive and negative-going spikes will be observed on the 'scope.

If a diode is connected across the resistor, either the positive or the negative-going spikes can be suppressed, the diode acting as an effective low resistance shunt to a spike of the appropriate polarity. The Schmitt is now being used as a source of trigger spikes which occur at well defined intervals synchronised to the frequency of the input waveform.

The triggering point on the input waveform is determined by the value of the trigger level voltage V_1. If the voltage spikes are carefully examined, it will be noticed that the positive and negative-going time constants are not the same. Neither are the amplitudes of the spikes equal .

To be continued

In Part 1 last month the following corrections should be noted:

1. Page 921, third para. to read: "Calculate the voltage drop along R_3 at saturation using Ohm's Law . . ."

2. Page 921, under "Transistor operated as a switch", to read:
Thus

$$V_{CC} = V_L + V_{CE}$$

But

$$V_L = I_C R_L$$

3. Page 922, Fig. 1.9: Diode D1 to be reversed.

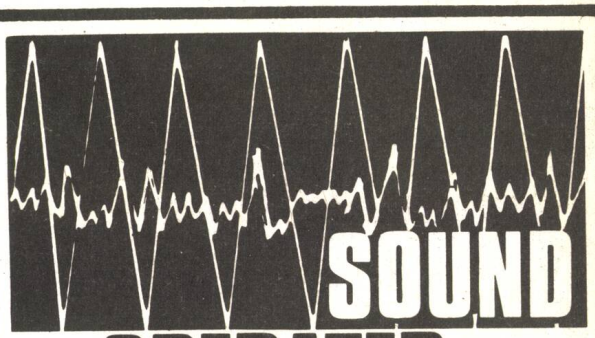
4. Page 922, Fig. 1.10a: Diode D1 to be reversed; TR1 is on holes 52, 57, 62; TR2 on holes 24, 29, 34; TR3 on holes 39, 44, 48.

5. Page 922, Fig. 1.10b: $I_{B3} = 0$ should read I_{B3}.

6. Page 923, under "Light operated AND circuit", fourth para. should read: "Typical voltage values are shown in Fig. 1.10b and c".

7. Page 923, eleven lines further down, should read: "Then $R_3 = (6 - 0{\cdot}4)/5 = 1{,}100$ ohms."

IN NEXT MONTH'S ISSUE !



SOUND OPERATED SWITCH

Possible applications are unlimited. They range from entertaining and amusing to serious, objective functions such as monitoring the occurence of some characteristic sound. A sensitivity threshold control is included.

RAINFALL GAUGE

Accurate measurement of rainfall with convenience of indoor monitoring. Flow of water is "digitised" and electrical pulses produced which actuate a remotely sited metering unit.

PRACTICAL ELECTRONICS

February issue on sale Thursday, January 15

ORDER YOUR COPY NOW!

P.E. WIDEBAND H.F. COMMUNICATIONS RECEIVER

By R. HIRST S.T.C. LTD. PART FOUR OSCILLATOR MODULES

THIS part of the "Communications Receiver" will describe the construction of two modules; the 2nd Oscillator and the 3rd Oscillator units (see Fig. 1.4). Both these modules were briefly described in part one of this series.

The 2nd oscillator provides the switching signal for the second mixer. The crystal used is of the overtone variety and as indicated earlier in this series is incorporated in an emitter circuit. The small value of output capacity (C42, 4·7pF) avoids damping the tuned circuit or introducing frequency pulling by the following stage (TR11).

CIRCUIT DESCRIPTION

Transistors TR11 and TR12 (Fig. 4.1) form a directly coupled amplifier which is inherently very temperature stable as the circuit tends to compensate for changes. This works in the following manner; assume that the base current of TR11 increases as a result of a temperature rise, therefore the collector current of TR11 will increase, causing the collector voltage to fall. As TR12 is an emitter follower the emitter voltage of TR12 will fall by a similar amount to the decrease in the collector voltage of TR11. This reduction in voltage consequently reduces the base current of TR11, via R48, and the collector voltage of TR11 starts to rise to offset the original fall. This obviously will apply in reverse if the temperature falls.

CRYSTAL TUNING

From the circuit diagram (Fig. 4.1) it is apparent that either a coil or a capacitor may be used in series with X1, both of which would be adjustable. If the correct crystal is purchased, which will be a few cycles low in frequency, a 6 to 24pF variable capacitor can be inserted and the frequency pulled up to precisely the correct value of 36MHz. However, if the crystal is high in frequency it becomes necessary to introduce a coil to pull the frequency down to the required value.

The coil used will depend upon the amount by which the crystal is high in frequency however, if the crystal is nominally 36MHz a coil of approximately 1·5 microhenries can be tried as a starting point. A coil similar to L5 in the r.f. unit can be used if approximately 12 turns are removed. The final assembly will be adjustable but it may be necessary to add or remove turns to suit the crystal. It must be pointed out that if the correct crystal is obtained it will not be necessary to do anything other than to insert a 6 to 24pF capacitor and adjust until the frequency is exactly 36MHz plus or minus 1Hz.

The setting up instructions indicate that the crystal should be removed and a 39 ohm resistor with a 470pF capacitor in series, should be inserted into the circuit at this point before adjusting L9. The reason for this is that it would be difficult to set the coil accurately with the crystal in circuit as the crystal would tend to indicate a constant frequency. If the coil is adjusted so that the free running frequency of the oscillator is accurate, the final circuit after the crystal has been re-inserted will be far more stable.

2ND OSCILLATOR CONSTRUCTION

The construction of this module should be undertaken in exactly the same way as has been described for previous modules. Points a and b shown on the

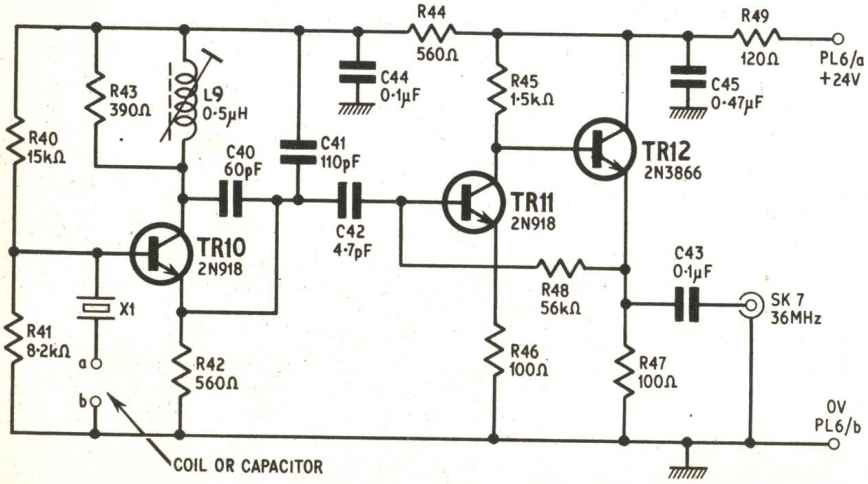
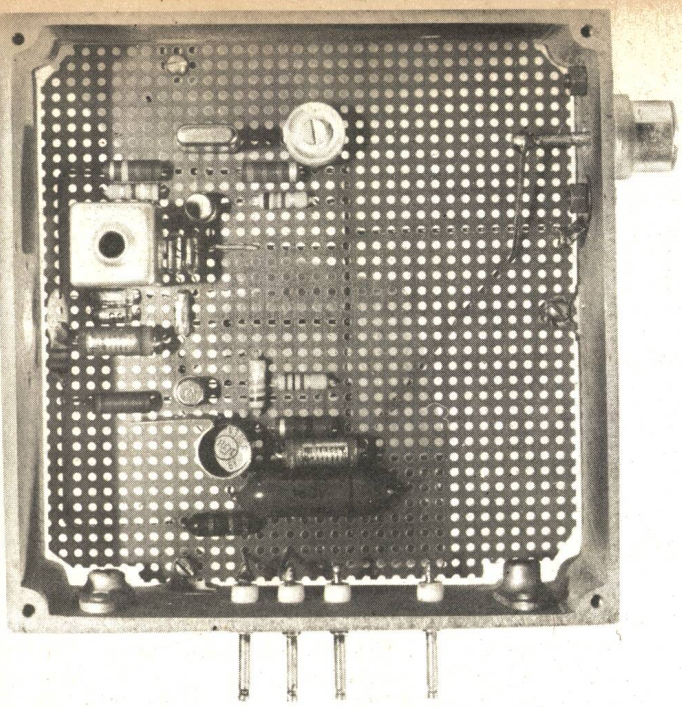


Fig. 4.1. Complete circuit diagram of the 2nd oscillator module

Table 4.1.
2nd OSCILLATOR
D.C. VOLTAGES

Stage		Voltage
TR10	Vc	12V
	Vb	4·5V
	Ve	3·9V
TR11	Vc	6·7V
	Vb	1·25V
	Ve	0·55V
TR12	Vc	15V
	Vb	6·7V
	Ve	6V



Second Oscillator Unit (36MHz) module

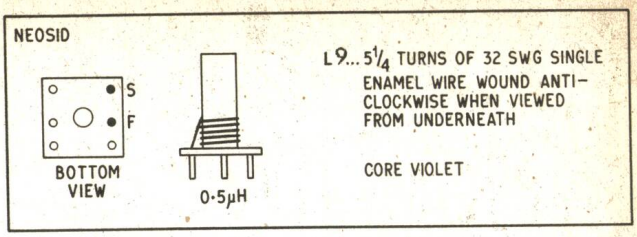


Fig. 4.3. Coil winding details

circuit diagram (Fig. 4.1) and on the construction diagram (Fig. 4.2) should be shorted temporarily during construction to facilitate initial d.c. checks on the circuit. The crystal X1 should be wired up in such a way that it is easily removed for setting up purposes.

Coil winding details for L9 are given in Fig. 4.3.

SETTING UP INSTRUCTIONS

Equipment required:

(a) **Power Supply,** 24V 50mA.

(b) **Valve Voltmeter** capable of measuring 1 volt at 36MHz.

(c) **Counter** capable of measuring 36MHz plus or minus 250Hz.

COMPONENTS . . .

2nd Oscillator

Resistors

R40	15kΩ	R45	1·5kΩ
R41	8·2kΩ	R46	100Ω
R42	560Ω	R47	100Ω
R43	390Ω	R48	56kΩ
R44	560Ω	R49	120Ω

All ¼W to ⅓W high stability, carbon film

Capacitors

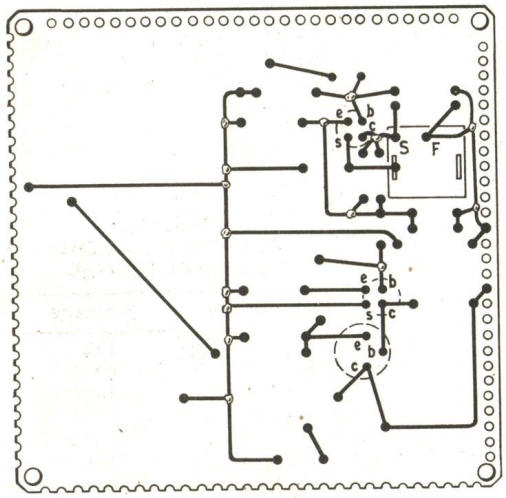
C40	60pF	polystyrene ±2·5% (39pF and 22pF in parallel)
C41	110pF	polystyrene ±2·5% (100pF and 10pF in parallel)
C42	4·7pF	polystyrene ±2·5%
C43	0·1μF	polyester or foil
C44	0·1μF	polyester or foil
C45	0·47μF	polyester or foil

Transistors

TR10 2N918
TR11 2N918
TR12 2N3866

Miscellaneous

X1 Overtone crystal (60Hz to 160Hz below 36MHz)
SK7 Coaxial chassis mounted socket
TO5 Heatsink
PL6/a, b, c, d Lead through connectors (4 off)
Veroboard 3½in × 3½in, 0·1in grid



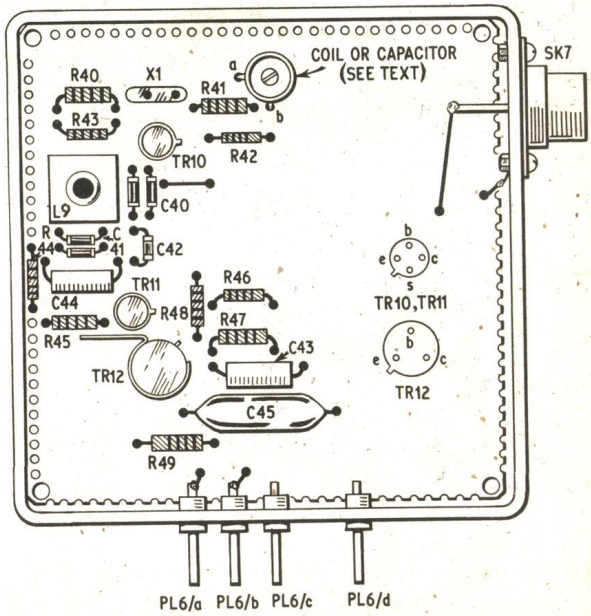


Fig. 4.2. Component layout and wiring of the 2nd oscillator module

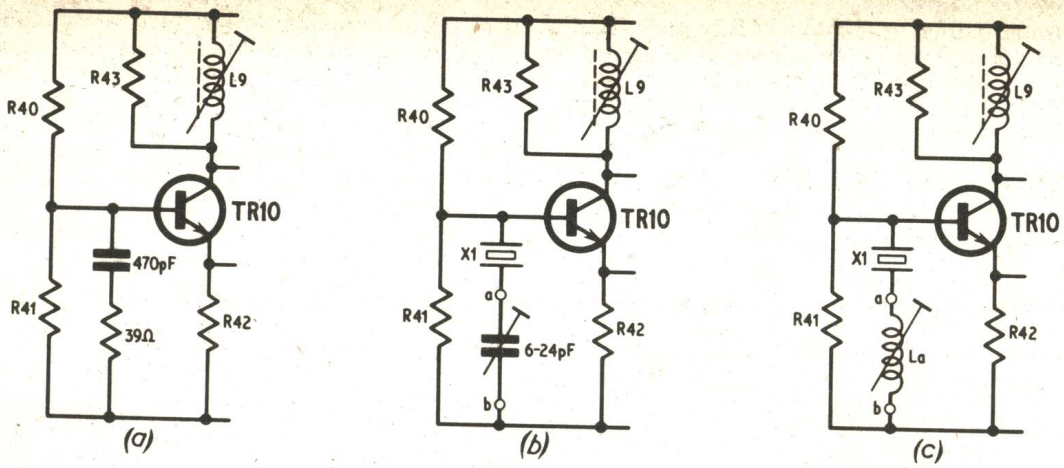


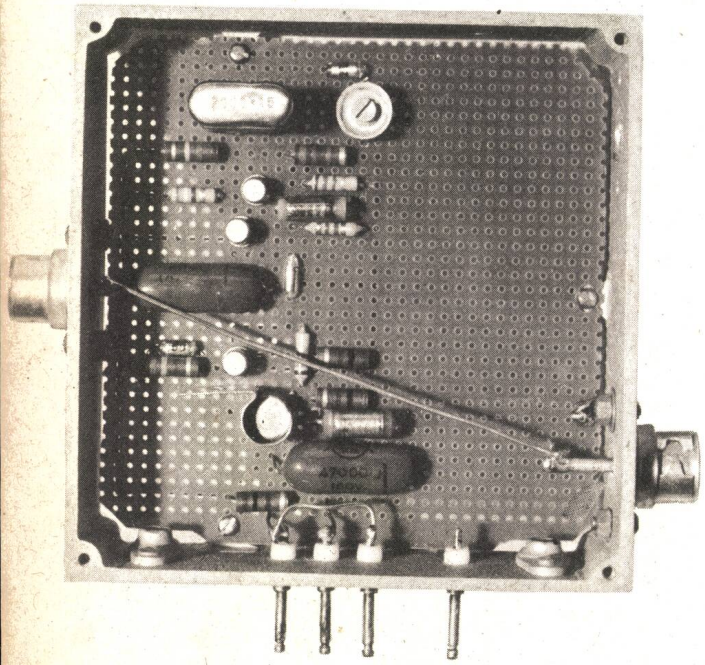
Fig. 4.4. Circuit alterations for setting up: (a) to set up L9, (b) connection for the correct crystal, (c) connection for a crystal which is high in frequency

PROCEDURE

Apply a positive voltage of 24V to the correct terminal (PL6/a) and the negative of the power supply to the earth terminal (PL6/b). Check all the potentials at the base, collector and emitter of all the transistors to ensure that they correspond with the levels given in Table 4.1. If these voltages are correct, replace the crystal with the resistor capacitor network shown in Fig. 4.4a. Connect the counter to output SK7 and adjust the frequency with L9 to read 36MHz as near as possible. Re-connect the crystal (removing the resistor capacitor network) and check the output frequency. If the frequency is lower than 36MHz, connect a capacitor, variable from 6 to 24pF between points a and b as shown in Fig. 4.4b. Adjust this capacitor until the output frequency is as near 36MHz as possible. If the frequency is too high then in place of the variable capacitor insert a coil similar to that described earlier in the text and adjust the coil until the frequency is 36MHz (see Fig. 4.4c). As previously mentioned, if the correct crystal is purchased then it should only be necessary to insert the capacitor and adjust as indicated.

Finally the output voltage at SK7 should be checked with a valve voltmeter to ensure that the output is approximately 0·8 volts when terminated in a 50 ohm load.

THIRD OSCILLATOR



Third Oscillator Unit (2MHz) module

The Third Oscillator Unit (2MHz), which was briefly described in part 1, provides the switching frequency for the last stage of frequency conversion. This oscillator uses two transistors with a 2·0MHz fundamental crystal in series connection.

CIRCUIT DESCRIPTION

Two transistors have been used in this particular circuit (see Fig. 4.5) so that the loading effect of the crystal and its series network is not placed directly across the collector of TR23 (thus reducing the gain to such an extent as to damp the ability of the circuit to oscillate). Transistor TR23A presents a relatively high impedance to the collector of TR23, thus promoting gain in the first stage, and at the same time provides a low output impedance to feed the crystal network.

The crystal is used in its series mode whereby the short circuit characteristic of the crystal in this type of connection provides a short circuit to the positive feedback signal at the required frequency of 2·0MHz. At either side of the operating frequency the crystal rapidly goes into a high impedance state thus effectively blocking the return path for positive feedback.

Transistor TR23 is operating in a grounded base configuration and the bias for both the transistors is developed by the potential divider comprising, R50 and R51. Capacitor C50 decouples the base to a.c. and has been placed on the underside of the board to keep the leads as short as possible. The crystal is pulled onto frequency by C51 which is in parallel with the larger fixed capacitor, C52.

The following pair of transistors, TR24 and TR25 form a directly coupled amplifier giving an output of approximately 1 volt at 2·0MHz into a 50 ohm load. Transistor TR25 is run at rather a high emitter current to keep the distortion to within a reasonable level.

CONSTRUCTIONAL DETAILS

Once again this module is constructed on plain Veroboard (see Fig. 4.6) and, where possible the component leads are used for wiring connections. There are no inductors in this module so construction can commence once all the components have been obtained. Capacitor C50 should be connected in such a way that it can be removed easily, if this proves necessary, during the setting up of this module.

An extra output socket (SK9) has been provided to enable the constructor to more easily set up the final receiver once the whole equipment has been built.

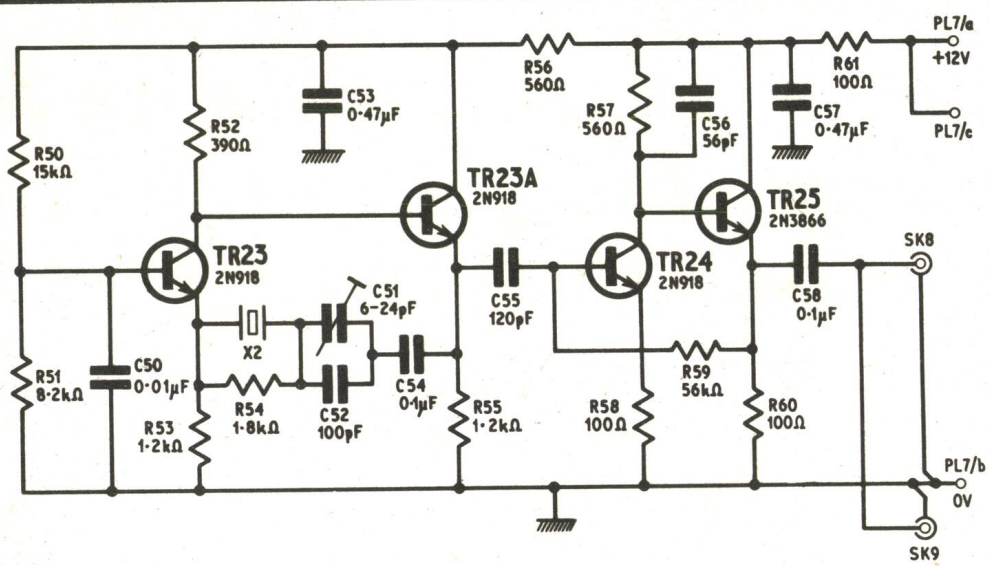


Table 4.2. 3rd OSCILLATOR D.C. VOLTAGES

Stage		Voltage
TR23	Vc	4·5V
	Vb	1·5V
	Ve	1·0V
TR23A	Vc	9·0V
	Vb	4·5V
	Ve	3·7V
TR24	Vc	5·3V
	Vb	1·0V
	Ve	0·3V
TR25	Vc	6·9V
	Vb	5·3V
	Ve	4·4V

Fig. 4.5. Complete circuit diagram of the Third Oscillator Unit (2MHz)

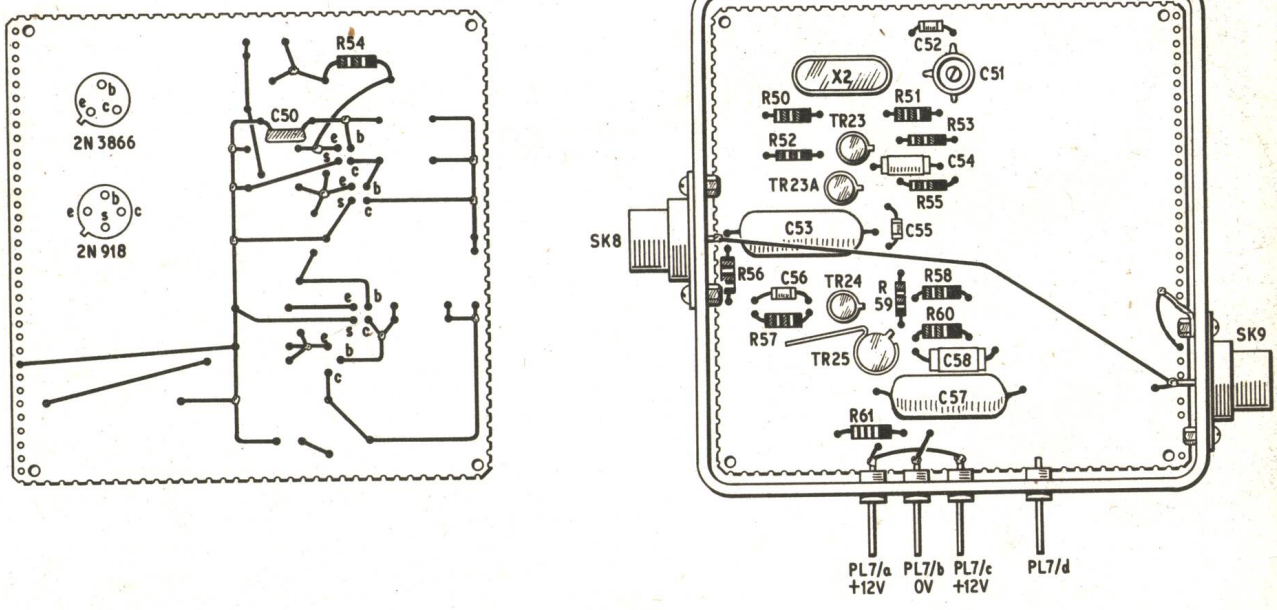


Fig. 4.6. Component layout and wiring of the Third Oscillator module

COMPONENTS . . .

Resistors

R50	15kΩ	R54	1·8kΩ	R58	100Ω
R51	8·2kΩ	R55	1·2kΩ	R59	56kΩ
R52	390Ω	R56	560Ω	R60	100Ω
R53	1·2kΩ	R57	560Ω	R61	100Ω

All ¼W to ⅓W high stability, carbon

Capacitors

C50 0·01μF ceramic
C51 6–24pF ceramic trimmer
C52 100pF polystyrene 2%
C53 0·47μF polystyrene
C54 0·1μF polyester
C55 120pF polystyrene 2%
C56 56pF polystyrene 2%
C57 0·47μF polyester
C58 0·1μF polyester

Transistors

TR23 2N918
TR23A 2N918
TR24 2N918
TR25 2N3866

Miscellaneous

X2 2·0MHz series resonant crystal
SK8, 9 Coaxial output sockets (2 off)
PL7/a, b, c, d Insulated lead through connectors (4 off)
TO5 Heatsink
Veroboard 3½ × 3½in, 0·1in grid

SETTING UP INSTRUCTIONS

Equipment required:

(a) **Power Supply,** 12V at 60mA.
(b) **Valve voltmeter** capable of measuring 1 volt at 2MHz.
(c) **Counter** capable of measuring 2·0MHz plus or minus 100Hz.

PROCEDURE

Apply the correct potential across PL7/a and b, switch on and check that the voltages at the base, collector and emitter of all the transistors correspond to the levels indicated in Table 4.2. If these voltages are correct to within 10 per cent a 50 ohm resistor should be connected across SK8 and a valve voltmeter connected at this point to ensure that there is some output.

A counter can now be connected to SK9 and the frequency adjusted to 2·0MHz, plus or minus 1Hz, by C51. It may be necessary to slightly change the value of C50 if the crystal cannot be pulled up to the required frequency. This could happen if the correct crystal has not been used. It is not essential to use the crystal specified but if an unknown device is used it may well present problems and the values of C52 and R54 may have to be experimented with.

Once the circuit is oscillating at the required frequency the output voltage should be checked with the valve voltmeter to see that the level lies between 0·6 volts and 1·0 volt r.m.s.

Note: the panel sizes given under "You Will Need" in Fig. 2.1 should be used, not those given in the diagram.
In Fig. 2.4, R7 should be joined to TR3 emitter.

Next month: Details of the Sideband Filter Unit and the A.F. Unit

NEWS BRIEFS

Computerised Power

WHEN Hunterston "B", the 1,250 megawatt nuclear power station being built for the South of Scotland Electricity Board, becomes operational in 1973, over 6,000 different points in its dual advanced gas cooled reactor (AGR) system will be monitored continuously by two Honeywell 316 computers working hand in hand.

The £300,000 Data Logging and Monitoring System, developed by Honeywell in conjunction with The Nuclear Power Group Ltd., will provide the station's operating staff with regular logs of all plant conditions and will instantly bring to their attention deviations from certain normal plant conditions.

The two computers of the system, using predetermined priority lists, will continually scan the gas outlets and thermocouples connected to each of the two reactors as well as a wide range of other parameters associated with the complete reactor/boiler/turbine system. As the reactor data is collected the computers will compare it with preset alarm limits and then, at the completion of each scan, print details on logging typewriters located in the station's control complex. If the values of particular monitoring points fall outside the corresponding alarm limits, the system will indicate the alarm condition by printing the relevant data in red.

Radar Alarm System

SHORROCK Security Systems Ltd., Blackburn, Lancashire, a subsidiary of Hawker Siddeley Dynamics, have introduced a new range of burglar and intruder detection devices using microwave Doppler radar. Until recently the cost of generating microwaves made radar too expensive for most intruder detection systems. But recent research by the Royal Radar Establishment, and in Shorrock's own laboratories, has now developed a technique of using a Gunn Diode to produce microwaves from a six volt torch battery.

Using this system Shorrock's have produced a complete range of portable and fixed radar-operated equipment which can detect intruders at distances of up to 50 yards.

An important feature of these devices is that they can be programmed to differentiate between a human intruder and accidental happenings, such as the falling of packing cases or the blowing about of leaves or paper, and so prevent false alarms. Jamming devices only cause the equipment to give an alarm as does the wearing of anti-radar clothing.

POINTS ARISING

DOUBLE SIX (*December 1969*)

Resistor R15 was incorrectly marked in Fig. 1. Its value should be 56kΩ. Also the polarity of C6 was shown incorrectly in all relevant diagrams—the negative side should be connected to the OV line.
Plug Connections (all plugs) shown in Fig. 4 should be reversed in order.

BOOK REVIEWS

THE HI-FI AND TAPE RECORDER HANDBOOK

By Gordon J. King
Published by Newnes-Butterworth
304 pages, 9in × 6in. Price 40s.

SINCE the author's earlier book *The Practical Hi Fi Handbook* went out of print, several of the chapters therein were extensively revised and up-dated for inclusion in this new volume. Much additional material is added to make this a valuable addition to the bookshelf.

The increased popularity of tape recording, from bird song to video recording, justifies fully the treatment given to the subject in this work; it must therefore include information on audio theory and circuitry generally used in hi fi equipment.

Some of the common problems in setting up, operating and fault finding in audio equipment are given extensive treatment to enable the tape recorder user to get the best from his equipment. Technical terms are explained and associated equipment, such as turntables and pick-ups, microphones, f.m. radio, and video are also covered, since the good tape recordist frequently has to rely on the efficiency of these ancillary items for first-class results.

Two useful appendices are given to explain amplifier performance specifications and list a wide range of test tapes and discs.

Readers with some knowledge of audio techniques and circuitry will find this book easy to follow; it is not intended as a tutorial text book but rather to help those already familiar with basic fundamentals who wish to graduate to quality recording.

M.A.C.

SERVICING WITH THE OSCILLOSCOPE

By Gordon J. King
Published by Butterworth & Co. (Publishers) Ltd.
176 pages, 8¾in. × 5½in. Price 38s. 0d.

PROBABLY one of the most neglected instruments in the workshop, the oscilloscope, has now assumed a potent role as a servicing tool since the advent of colour television. With this renaissance has come the need for 'scopes with a laboratory specification specially tailored to encompass the broad video bandwidth and short pulse rise times found in modern television servicing.

In introducing the oscilloscope Mr King succinctly describes its function as "it takes a whole series of 'instantaneous' changes—a slice of time—and lays it before us as a diagram".

The concern with diagrams, or oscillograms to give them their correct term, is made apparent in the succeeding pages. From introductory chapters familiarising the reader with the fundamental features and applications of the 'scope we are led into fault diagnoses by oscillogram analysis of video, synchronising and timebase waveforms. Typical circuit stages showing Y amplifier test points facilitate the rapid practical reproduction of those traces where servicing is intended.

It is in company with the sine/square wave signal generator and wobbulator that the oscilloscope assumes its most comprehensive service capability. With these, hum, distortion and response tests for both video and audio equipment can be carried out in addition to visual sweep alignment of i.f. stages.

Chapters embracing the use of these auxiliary instruments and the interpretation of the display patterns formed are adequately covered.

Whilst many of the waveforms found in monochrome television are present in colour sets, the latter do include circuits designed to process colour signals and control the unique three-gun tube. For a fuller understanding of the waveforms involved there is a chapter on the basic colour principles.

The final two chapters are concerned with stereo radio waveforms and the testing of audio equipment. In the latter we are shown how to use the "magic eye" to make meaningful—or should it be meaningless—the hi fi specification.

For anyone owning, or intending to purchase a 'scope, this book should prove a useful investment.

G.G.

TRANSISTOR AUDIO AND RADIO CIRCUITS

Edited by A. Peters
Published by Mullard Limited
203 pages, 8½in × 6in. Price 30s.

AUTHORITATIVE books of this kind giving basic design features and proven circuits are a valuable asset to any experimenter. One often finds Mullard circuits reproduced in technical books that are treated with respect and adopted in many practical projects.

In this book we have it all "from the horse's mouth", together with background details of the designs and the results of laboratory tests. It follows a similar style to Mullard's red paperback produced several years ago.

The important difference here is that fundamental transistor characteristics are excluded, since these are available from a multitude of other publications. The space is better used on the design criteria.

Since the publishers have got down to the business of printing complete circuit designs, one really wonders if the manufacturing techniques of transistors given in Chapter 1 is really appropriate.

The remainder is intended to help circuit designers and constructors who have some background knowledge of the subject and are able to adopt their own layout methods and know how to use test equipment.

A complete list of the designs shown would fill this page, so it will suffice to mention them in broad terms under audio amplifiers, i.f. and r.f. stages, a.m. and f.m., tape recorder circuits, mono and stereo control circuits, test equipment, charts, graphs, and nomograms. Components lists are provided with current manufacturers' names. Mullard have gone to some lengths to provide such a comprehensive book, the like of which will be hard to find elsewhere. To those interested in domestic equipment construction this will be money well spent.

M.A.C.

PE ORGAN PART 9

By Alan Douglas, Sen. Mem. I.E.E.

THIS MONTH we are concerned with the wiring of the pedalboard and the carpentry of the organ stool.

PEDALBOARD TYPE

The pedalboard used with the organ is the 30 note type D from Kimber-Allen Ltd. This model has full width concave and radiating short length pedals, curved toe and heel board and heel springing. It has the advantage of being a condensed form of full-sized pedalboard; here the reduction being in area, not in note compass.

PEDAL KEYING

As we key the pedal signals from the dividers directly with the foot, the 16ft and 8ft circuits are made up of simple single pole switches. The two are combined in one Kimber-Allen contact block type GB, there being one block to each key.

Fig. 9.1 shows how the depression of a pedal actuates the switches. The gold contacts are made with wipers which can also be bought from Kimber-Allen. These are type C.W.K.S. to suit the $\frac{1}{2}$in contact assemblies.

Since a metallic contact must not be made, the turned over edge of the wiper has a $\frac{1}{2}$in of plastic sleeving slotted and slipped over the end. This is then secured by a drop of Bostik or similar cement. Note in Fig. 9.1 the use of a No. 3 woodscrew to adjust the stroke of the wiper.

Fig. 9.2 shows the wiring of the contact blocks. Here the signal inputs originate from the 100 kilohm pedal resistors. These are then routed from the 16ft and 8ft sockets as described in Part Four, thence to the contact blocks via additional plugs and sockets.

The plain wires of the blocks are connected to the 16ft and 8ft busbars. The bent wires connect to the signal sources. When the contacts are individually keyed the signals are routed back by way of pins 31 and 32 of a pedal socket to the related tone forming circuits. These pins are shown in Fig. 4.1.

ADDITIONAL PLUGS AND SOCKETS

Before getting involved in the pedalboard wiring it is a good idea to first make up the cableforms for mating the pedalboard to the organ console. For this two 32-way plugs and two 32-way sockets are required, these being identical to those called up in Fig. 4.1. Each plug and socket is wired with 3 ft lengths of p.v.c. stranded wire, the order of connection given as in Fig. 4.1. When this is completed you should have two terminated looms for 16ft and 8ft pitches, one being shown in the photograph.

MOUNTING THE BLOCKS AND WIPERS

As our pedalboard is a proper radiating and concave one, the contacts when fixed must describe an arc of a circle. This means that some rigid form of backing must be provided beneath the keys. To achieve this three 1in by 1in hardwood battens are fixed to the frame as shown in Fig. 9.3. Single screw fixing is possible at the toe end, but brackets are necessary at the heel.

To carry the contact blocks a strip of $\frac{1}{4}$in ply is screwed to the battens, this being supported at the frame side by small screwed wooden blocks. In the figure two strips are shown. Here, the lower one will provide a platform for sustain contacts if these are used. However, more about this aspect later.

The main blocks are cemented on with Bostik. When those are fixed we can attach the contact wipers, these being held to the keys by $\frac{3}{8}$in No. 3 woodscrews. Of course, the adjustment screw shown in Fig. 9.1 should also be included.

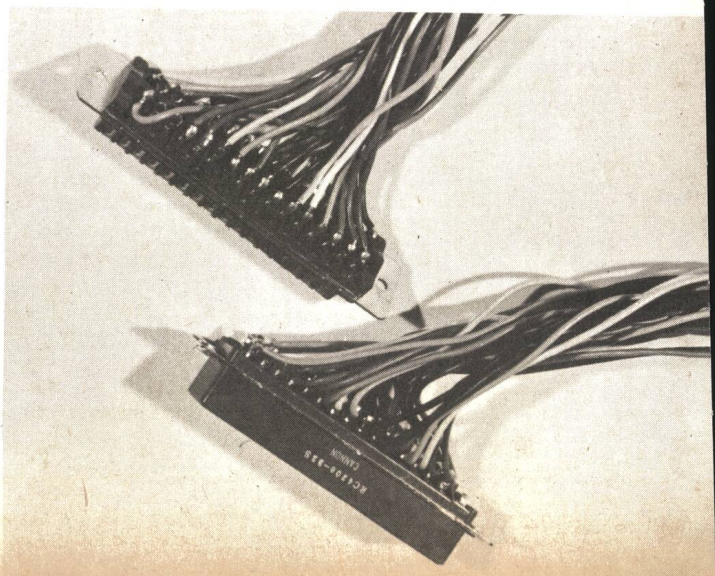
Prior to any wiring the tails of the blocks should be splayed out as this will facilitate later soldering.

WIRING THE BLOCKS

We are now in a position to connect wires to the contact tails. In the accompanying photograph of the pedalboard underside, the extreme left-hand pedal will produce the highest note; the extreme right that of the lowest note. Using the colour code of Fig. 4.1 and the specimen wiring diagram of Fig. 9.2 we can wire from the block tails for the 16ft pitch moving from left to right at the pedal contacts. As the loom forms it should be supported at the ply strip with thin nylon cord.

With the 30 connections made and the loom gathered, holes can be drilled midway along the frame side for taking the wires through. Now the free ends are bared and connected to one of the 32-way plugs called up in the components list of Fig. 4.1. This figure also gives the wiring order for the plug pin connections.

Cannon plug and socket wired to pedalboard loom



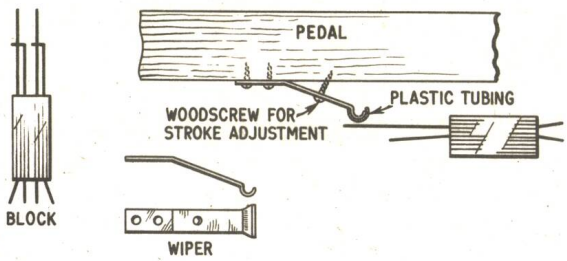


Fig. 9.1. Contact block and wiper used in pedal note switching. Note the inclusion of the stroke adjusting woodscrew which makes for switching precision

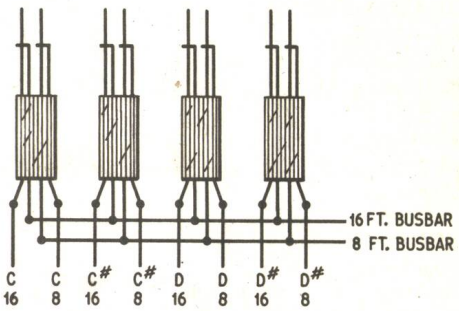


Fig. 9.2. Four representative contact blocks with their tails wired. All 30 blocks should be wired in this fashion

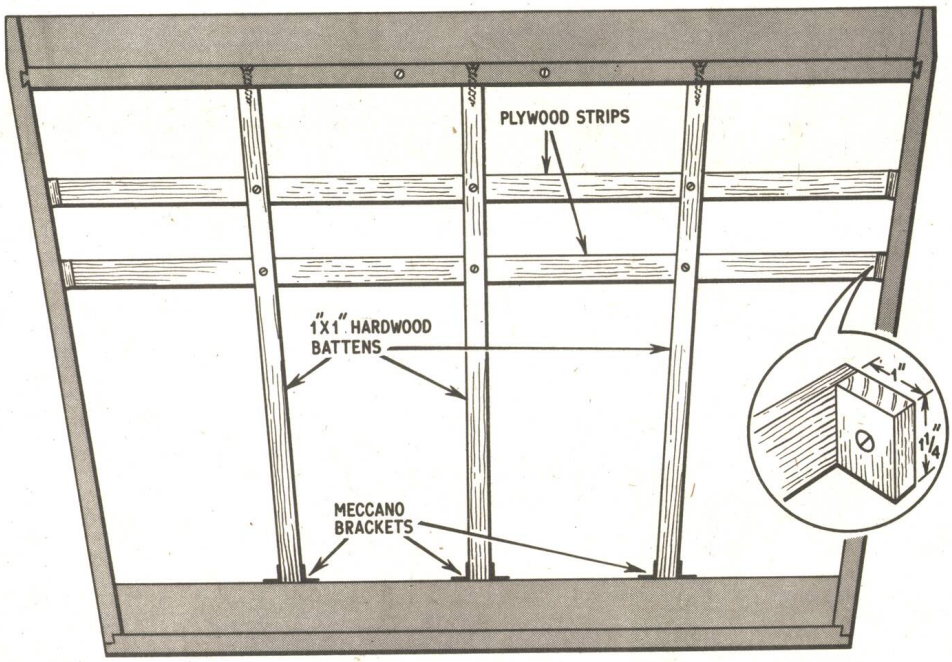
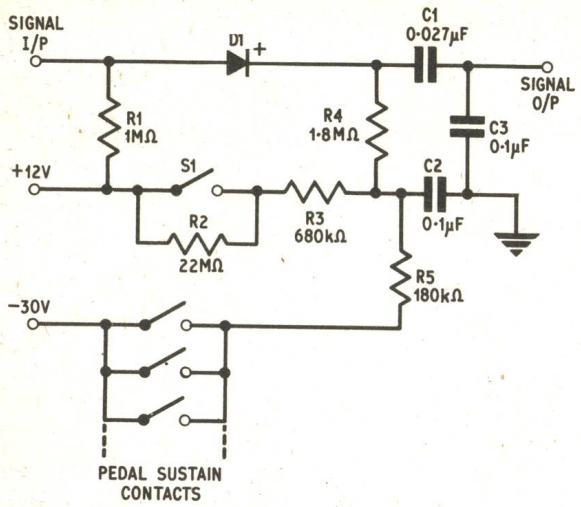


Fig. 9.3. Underside of pedalboard, with keys removed, showing batten and strip frame in position. The upper transverse strip will carry the GB contact blocks, the lower strip the GJ blocks if sustain is required

PEDAL SUSTAIN CIRCUIT



COMPONENTS . . .

PEDAL SUSTAIN GATE
(2 required)

Resistors
R1 1MΩ
R2 22MΩ
R3 680kΩ
R4 1·8MΩ
R5 180kΩ
All 10%, ½ watt carbon

Capacitors
C1 0·022μF polyester
C2 0·1μF polyester
C3 0·1μF polyester

Diode
D1 OA210 (Mullard)

Fig. 9.4. Circuit for pedal sustain. All the pedalboard contacts of the GJ blocks are connected in parallel

8FT CONTACT WIRING

For the 8ft contact wiring the procedure is the same and when completed this loom can be also attached to the strip. Again these 30 wires terminate at a separate 32-way plug.

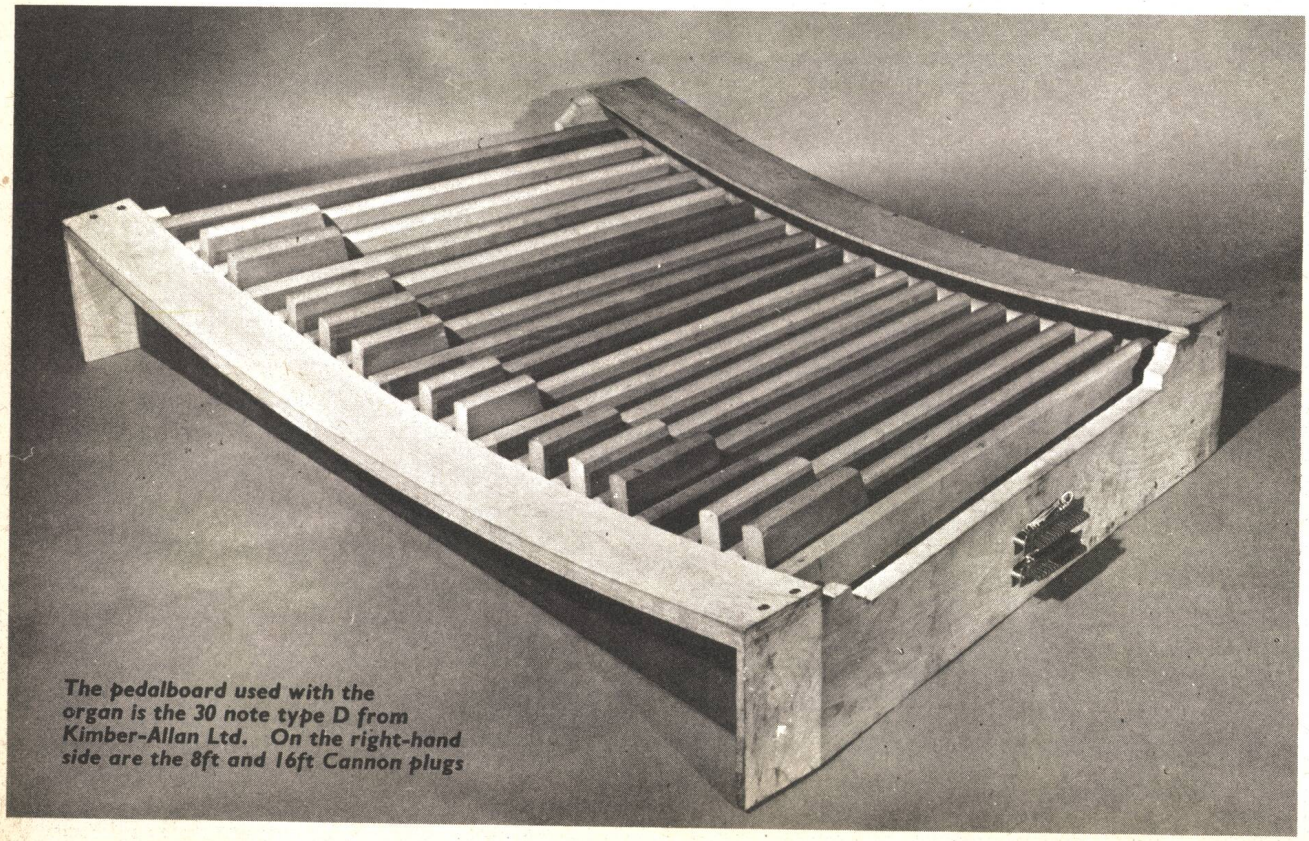
The two plugs can now be fixed to the frame sides with wood screws and stand-off bushes, making sure that the contacts are clear from the wood.

PEDAL SUSTAIN

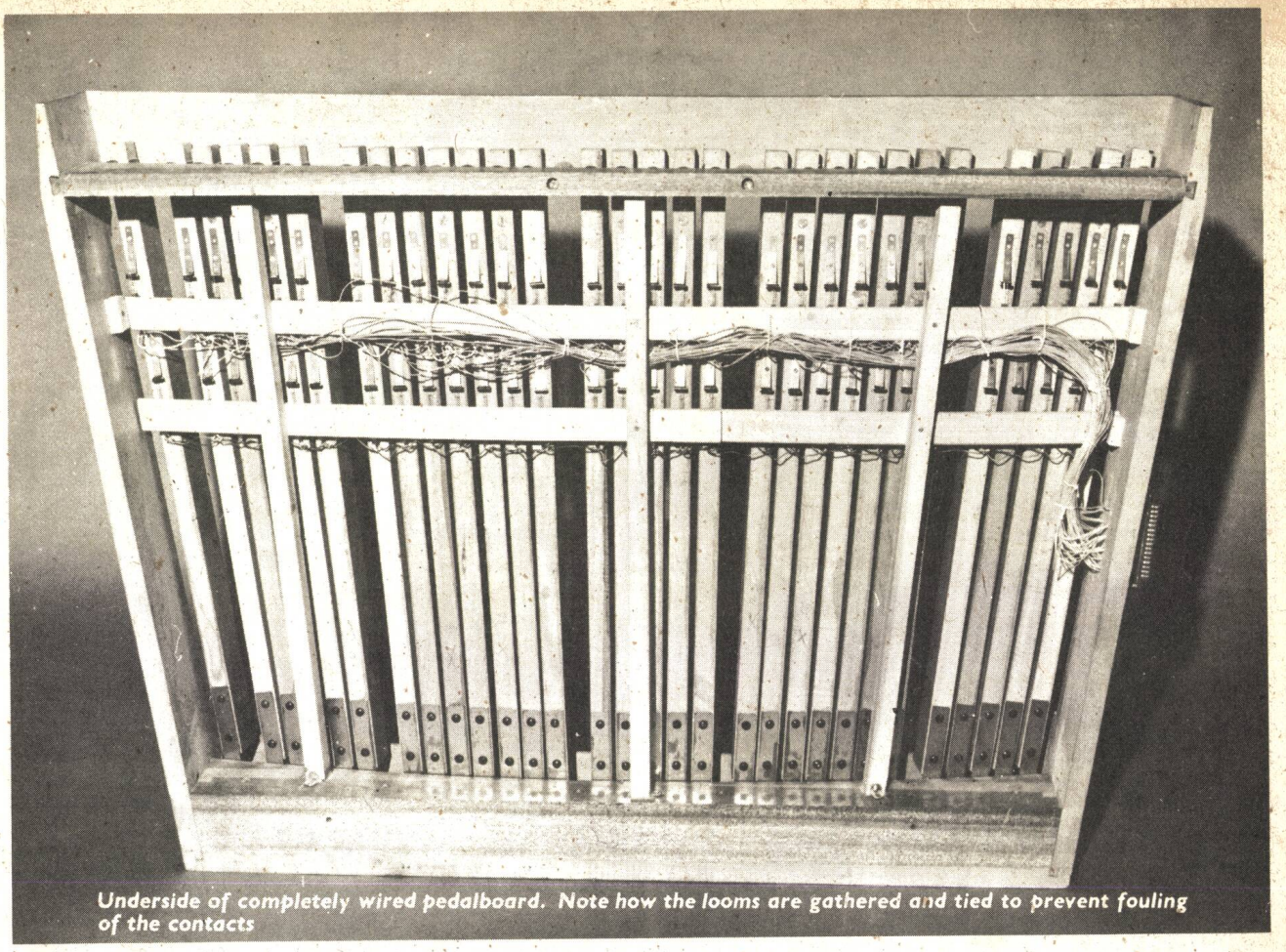
It is quite easy to apply sustain because we are assuming that only one note at a time will be played; hence only one sustain circuit for each pitch is required. The fact that only one note at a time is played means that we can have an electrical sustain with the advantage that the sustain time can be altered at will or removed altogether.

In using auxiliary circuits of this kind, it is usual to close one contact before the other. The normal 16ft and 8ft pair of contacts are closed, which applies the bias to the sustain device.

There is no convenient single pole organ contact on the market, but one side of the Kimber-Allen change-over contact type GJ is suitable. All we need is a



The pedalboard used with the organ is the 30 note type D from Kimber-Allan Ltd. On the right-hand side are the 8ft and 16ft Cannon plugs



Underside of completely wired pedalboard. Note how the looms are gathered and tied to prevent fouling of the contacts

simple single pole switch, but it is an advantage to use the K-A parts because the point at which closure is made is so easily and accurately adjusted by the stroke setting screw of the wiper.

If we intend incorporating sustain then the GJ contacts and wipers should be attached, the former being cemented to the lower transverse ply strip. The sustain switches are wired in parallel. This is made clear in Fig. 9.4. When all solder connections are made, the two free ends are terminated at pins 31 and 32 of the plug that has these pins vacant.

SUSTAIN CIRCUIT

In Fig. 9.4 is shown the sustain circuit. Two of these are required, one for the 16ft pitch and one for the 8ft. Since this is basically a gate it can be inserted before the pedal pre-amplifiers.

POWER SUPPLY FOR PEDAL SUSTAIN GATE

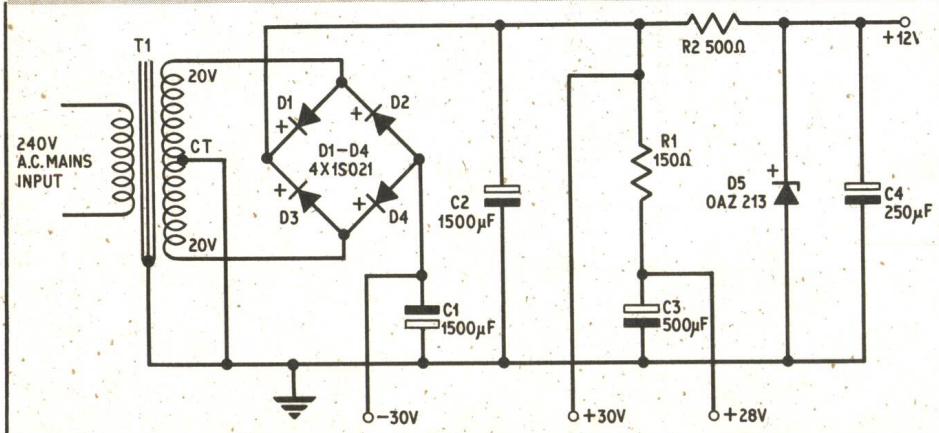


Fig. 9.5. Circuit of power supply required for pedal sustain gate. The additional voltage taps are for manual sustain. A gate for this will appear in a later article

COMPONENTS . . .

GATE POWER SUPPLY

Resistors

R1	150Ω	½ watt
R2	500Ω	1 watt

Capacitors

C1	1,500μF	100V elect.
C2	1,500μF	100V elect.
C3	500μF	50V elect.
C4	250μF	25V elect.

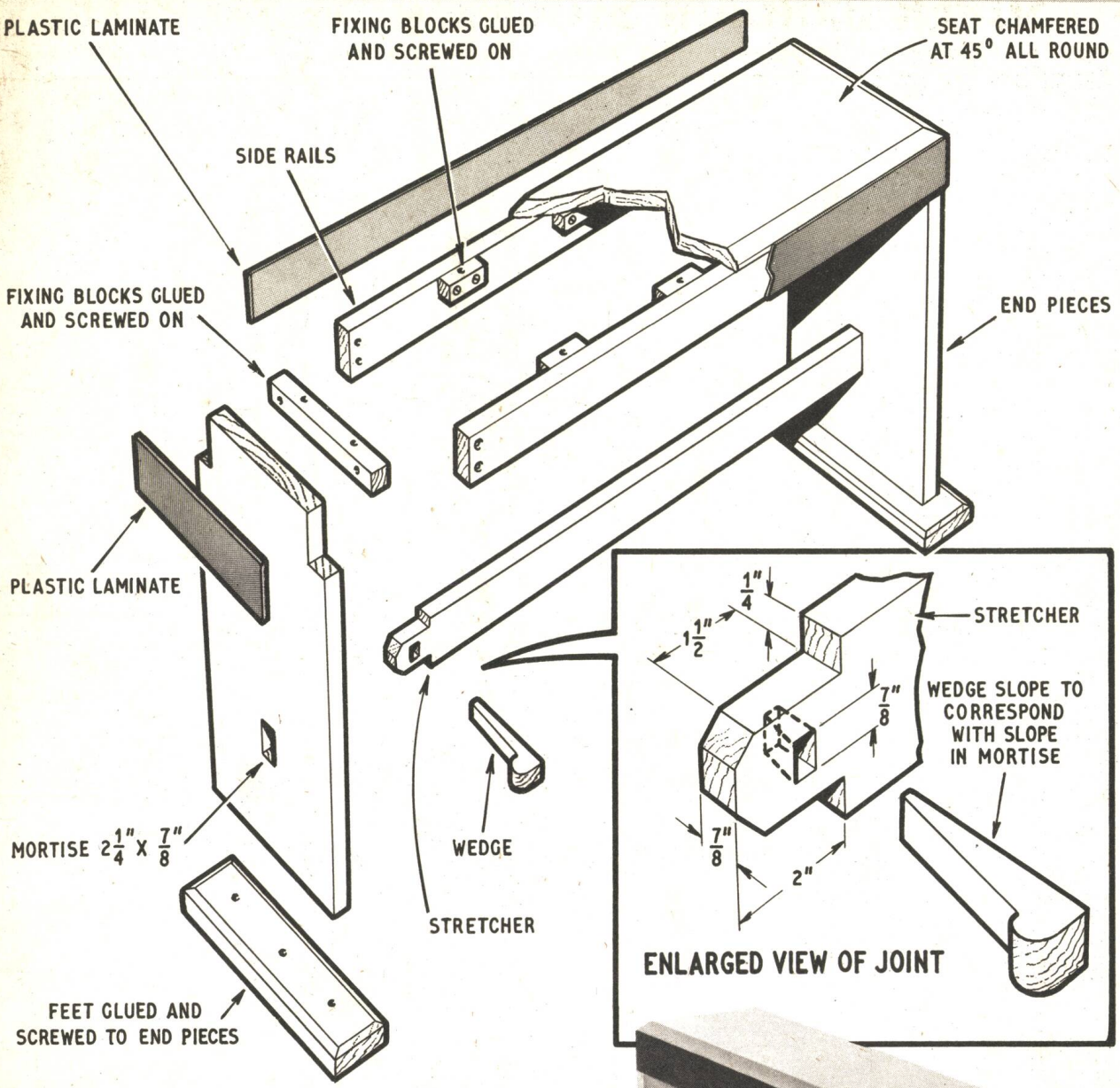
Diodes

D1–D4	IS021 (4 off)
D5	OAZ213 Zener

Transformer

T1	20V–0–20V Rec. Transformer (Radiospares)

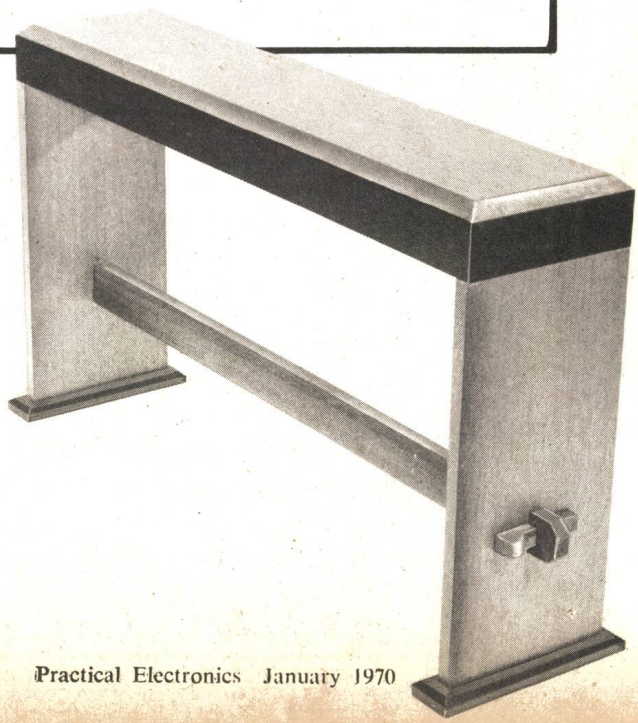
Fig. 9.6—ORGAN STOOL



Cutting List

End Pieces	(2 off)	25in × 10in × $\frac{7}{8}$in
Side Rails	(2 off)	44in × 2$\frac{3}{4}$in × $\frac{7}{8}$in
Stretcher		48in × 2$\frac{3}{4}$in × $\frac{7}{8}$in
Wedges	(2 off)	5in × 1$\frac{1}{4}$in × $\frac{7}{8}$in
Feet	(2 off)	12in × 2$\frac{3}{4}$in × $\frac{7}{8}$in
Fixing Blocks	(6 off)	2$\frac{3}{4}$in × 1$\frac{1}{4}$in × $\frac{7}{8}$in
Fixing Blocks	(2 off)	8$\frac{1}{4}$in × 1$\frac{1}{4}$in × $\frac{7}{8}$in
Seat		44in × 10in × $\frac{7}{8}$in

Also required: Plastics Laminate; 1$\frac{1}{2}$in × No. 8 countersunk woodscrews and glue.



SUPER BARGAIN STOCKTAKING SALE!!!

Use the form below for your order. **CONDENSERS MUST BE ORDERED BY STOCK NUMBER ONLY.** If any sale item is "sold-out" when order received we shall substitute items of equal value.

ELECTROLYTIC CAPACITORS

Stock No.	Capacity	Voltage	Price	No. Req'd	£ s. d.
1	1μF	6	4d		
2	4μF	25	4d		
3	4μF	4	4d		
4	6μF	6	4d		
5	3μF	25	4d		
6	64μF	9	4d		
7	20μF	6	4d		
8	20μF	50	6d		
9	30μF	15	6d		
10	8μF	12	4d		
11	8μF	6	4d		
12	1μF	350	6d		
13	8/8/8	350	1/–		
14	50μF	6	4d		
15	100/200	275	6/–		
16	32	150	9d		
17	64	2·5	3d		
18	100/200/200/50	275	7/6		
19	50/80	300	3/–		
20	150/200	275	6/–		
21	24	275	1/–		
22	10	25	3d		
23	125	2·5	3d		
24	2	150	3d		
25	16/32	350	2/6		
26	32	275	1/6		
27	350	12	6d		
28	75/75/75/75	150	2/6		
29	1	20	3d		
30	12·5	40	9d		
31	640	2·5	3d		
32	3,000	35	7/6		
33	3,000	15	3/–		
34	3,000	30	7/–		
35	250	70	2/–		
36	2,500	9	2/–		
37	32	50	9d		
38	750	12	1/9		
39	100μF	275	2/6		
40	30μF	10	3d		
41	2,000/2,000	25	7/6		
42	16μF	50REV	2/–		
43	16/16	275	2/–		
44	16	275	1/–		
45	350	12	9d		
46	20/4	275	1/–		
47	250	50	2/–		
48	500	25	1/6		
49	400	15	1/–		
50	400	2·5	3d		
51	64	275	1/9		
52	32/32	350	2/6		
53	8/8/8	275	1/9		
54	500	6	6d		
55	64	275	1/3		
56	25	6	3d		
57	100	9	6d		
58	400	50	2/–		
59	400	30	1/6		
60	500	4	3d		
61	150	30	1/6		
62	64/32/8	275	2/6		
63	200	275	2/6		
64	40	6·4	3d		
65	50	25	6d		
66	250	50	1/9		
67	30	6	3d		
68	100/100/50	275	5/–		
69	50/50/50	350	4/–		
70	40/40/20	275	2/–		
71	400	6·4	3d		
72	320	10	3d		
73	32/32 +25	275 25	2/6		

Total:—

RESISTORS. 5% EXCELLENT QUALITY. 7/6 per 100 or 2/– per doz.
Tick the values required.

13 ohms	220 ohms	1·5k Ω	3·6k Ω	7·5k Ω	22k Ω	39k Ω	62k Ω	130k Ω	560k Ω	1·8M Ω	7·5M Ω
22 ohms	470 ohms	1·8k Ω	4·3k Ω	10k Ω	24k Ω	43k Ω	75k Ω	360k Ω	620k Ω	3·6M Ω	8·2M Ω
36 ohms	560 ohms	2·2k Ω	4·7k Ω	16k Ω	27k Ω	47k Ω	82k Ω	430k Ω	1·2M Ω	5·1M Ω	9·1M Ω
47 ohms	750 ohms	2·4k Ω	5·6k Ω	18k Ω	30k Ω	51k Ω	91k Ω	470k Ω	1·5M Ω	6·2M Ω	10M Ω
91 ohms	1k Ω	3·3k Ω	6·8k Ω								

or our selection (mixed) 6/6 per 100 Total:

SILVER MICA/CERAMIC/POLYSTYRENE CONDENSERS 10/– per 100, 3/– per doz.
Available in following values. Tick those required.

2pF	5pF	12pF	25pF	50pF	80pF	135pF	180pF	250pF	680pF	1,000pF	2,500pF
3·9pF	6pF	15pF	27pF	58pF	82pF	140pF	190pF	330pF	800pF	1,100pF	2,700pF
4pF	8pF	18pF	30pF	62pF	100pF	158pF	200pF	420pF	820pF	1,500pF	3,000pF
4·7pF	10pF	22pF	39pF	72pF	125pF	170pF	240pF	600pF	900pF	2,200pF	6,200pF

Total:

COMPARE THESE PRICES

MULLARD POLYESTER CONDENSERS

	No.	Price
1,000 pF 3d ea. 400V		
1,500 pF 3d ea.		
1,800 pF 3d ea.		
2,200 pF 3d ea.		
0·15 μF 6d ea. 160V		
0·22 μF 6d ea. 160V		
0·27 μF 6d ea. 160V		
1 μF 1/– ea. 125V		

Total: _____

25% discount lots of 100 per type.
50% discount lots of 1,000 per type.

GANGED STEREO POTS. 250K Ω, 2/6 ea.

SKELETON PRESETS. Mixed. 6/– doz.

VOLUME CONTROLS. ½ MΩ, 1 MΩ, with D.P. switch, 2/– ea.

TELEVISION REMOTE CONTROLS. Philips, contain 11 7-way cable, 1 double pot., 5 resistors, two condensers, 10/– ea. (cost £3/3/–).

THIN CONNECTING WIRE
10yd 1/– 100yd 7/6. 1,000yd 50/–

CO-AXIAL CABLE. Black. 6d yd, £1 50 yd.

CRYSTAL MIKES. 10/– ea.

TRANSISTOR BARGAIN! THEY CAN'T GET ANY CHEAPER!!!

P.N.P. Audio, Untested, unmarked.	MAINLY O.K.,	10/– per 100.
N.P.N. Silicon. R.F. types, unmarked.	ALL USABLE,	10/– per 50.
POWER OUTPUT (Similar OC35)	ALL TESTED,	4/– ea; £2 doz.

SILICON PLANAR TRANSISTORS. ALL TESTED. NO LEAKS OR SHORTS
Gain of 20/50, 6d ea.; 50/100, 9d ea.; 100/200, 1/– ea.
Transistors similar to OCP71 (Light sensitive) 2/– ea.

THYRISTORS 400V BTY79, 7/6 ea. SCR51 (10A), £1 ea.

RECTIFIERS Latest type. All marked. 800V peak, 1A mean current type IN4006

	2/6 ea., 24/– doz, £7/10/– 100.
S.T.C. 3/4 (400V),	2/6 ea., 24/– doz, £7/10/– 100.
BYZ 13 or 19 (6A),	2/6 ea., 24/– doz, £7/10/– 100.

RECORDING TAPE GIVE-AWAY!!!
ALL BRITISH MADE, BEST QUALITY. 5in, 600ft, 7/3; 5½in, 900ft, 9/–; 7in, 1,200ft, 12/–.
3in "odd-ends"—may be standard, long or double play—but minimum 150ft, 2/3.

MAINS DROPPER TYPE RESISTORS. Hundreds of types from 0·7 ohm upwards. 1W to 50W. A large percentage of these are Multi-tapped droppers for radio/television. Owing to the huge variety these can only be offered "assorted", 10/– per doz.

GIANT SELENIUM SOLAR CELLS. Last few to clear at half price!
Circular, 67mm diameter, 5/– ea.; 50 × 37mm, 3 for 10/–.

RECORD PLAYER CARTRIDGES
ACOS GP67/2, 15/– (Mono)
GP91/3, 20/– (Compatible)
GP93/1, 25/– (Stereo)
GP94/1, 30/– (Stereo, ceramic)
GP93/1 with diamond needle, 32/6
GP94/1 with diamond needle, 37/6

TRANSISTORISED FLUORESCENT LIGHTS. 12V.
8W 12in tube, Reflector type, 59/6
15W 18 in tube, Batten type, 79/6
Complete with tube. Postage 3/–

TRANSISTORISED SIGNAL INJECTOR KIT 10/–

TRANSISTORISED SIGNAL TRACER KIT 10/–

TRANSISTORISED REV. COUNTER (CAR) 10/–

VERO-BOARD

2½ × 1 × 0·15in, 1/3	17 × 3¾ × 0·15in, 14/8
3¾ × 2½ × 15 in, 3/3	3¾ × 2½ × 0·1in, 4/2
3¾ × 3¾ × 0·15in, 3/11	3¾ × 3¾ × 0·1in, 4/9
5 × 2½ × 0·15in, 3/11	5 × 2½ × 0·1in, 4/7
5 × 3¾ × 0·15in, 5/6	5 × 3¾ × 0·1in, 5/6
17 × 2½ × 0·15in, 11/–	

Spot Face Cutter 7/–. Pin Insert Tool, 9/6.
Terminal Pins, 3/6 for 36.
Spot Face Cutter and 5 2½ × 1in boards, 9/9.

These prices cannot be repeated. Order now. Don't forget to add your name and address! Please include suitable amount to cover post and *packing*. Minimum 2/–.

G. F. MILWARD - DRAYTON BASSETT - Nr. TAMWORTH, STAFFS - Phone TAMWORTH 2321

The circuit functions as follows. A blocking voltage of +12V charges the sustain capacitor C2 through R3. With this charged it reverse biases the diode D1 through R2. The pedal signal can now pass.

When a pedal is depressed, −30 volts is applied to C2 through R5, charging it negatively. This voltage then passes through R5 to the diode D1, forward biasing it and allowing the signal to pass. When the key is released, the +12 volt input again charges C2 and blocks the signal off. If the sustain switch S1 is opened, the resistor R2 is introduced between the +12 volt input and C2 resulting in a long charging time, which in turn results in delayed reverse-biasing of the diode.

By selection of R2 we can get a sustain of up to about four seconds, and by shorting it out, we get instantaneous "speech". This is a very useful feature, especially if one's pedalling technique is lacking.

A small additional power supply is required to provide the necessary voltages and this is given in Fig. 9.5. For the sustain switch S1, one of the spare stop units can be used.

ORGAN STOOL

The most important requirement for an organ stool is absolute rigidity. To ensure this wedges were used to fix the stretcher as shown in Fig. 9.6. If the wedges were to work loose they can easily be tapped back tight with a mallet.

First the end pieces are cut to size from mahogany, the dimensions being given in the cutting list. Shoulders are then cut in the top corners of each piece, these being 2¾in by ⅞in. These eventually contain the ends of the side rails.

A 2¼in by ⅞in mortise is then cut at the centre of the width and 6¼in up from the bottom of both end pieces. This last dimension is most important as the stretcher when in position in the mortise must be clear of the pedalboard.

Next the two side rails are cut to length. Then two ¼in diameter countersunk holes are drilled $\frac{7}{16}$in from each end through the thickness of the timber. With these rails completed, the third rail or stretcher is tackled. This is longer than the other rail as its tenons will have to protrude through the end pieces. Dimensions for making the tenons are shown in Fig. 9.6.

The feet and the seat can now be cut to size. In completing these a ¼in chamfer at 45 degrees was made at the edges.

To hold the seat in position, screw blocks are cut, glued and then screwed in position. With the seat glued and the feet attached the stool can be finally rubbed down with glass paper.

FINISHING

As a decorative surround, black plastic laminate can be glued at the stool side.

The feet are painted black and the remaining wood surface is given two coats of matt polyurethane varnish.

CORRECTIONS PART—7 (November 1969)

Note: In Fig. 7.2, page 832, the resistor at 27*B*/27*D* should read R3; the resistor at 29*B*/29*C* is R5; the resistor at 29*D*/29*H* should read R4. In Fig. 7.3 there should be a break in the copper strip at hole 16*F*.

Next month we will commence construction of the loudspeaker enclosure and final organ tuning.

NEWS BRIEFS

Faraday Lectures

THE forty-first in the series of Faraday Lectures arranged by the Institution of Electrical Engineers are being given by Mr J. H. H. Merriman on the subject "People, Communications and Engineering". Mr Merriman is the Senior Director (Development) with the Post Office and is also member for technology on the board of the Post Office Corporation. Deputy lecturer is Mr C. A. May, Staff Engineer in Post Office Telecommunications Development Department.

The Lecture is being given in 13 towns in the British Isles; the first was at Rugby, followed by Southampton and Bristol. Other venues will be as listed below.

The Faraday Lecture series spotlights various aspects of modern electrical and electronic science and technology in straightforward language for the general public. Special presentations for students are being arranged at all towns on the tour. Members of the public are admitted by ticket, free of charge, to these lectures.

Venues

Nottingham, Albert Hall ; January 13
Stoke-on-Trent, Victoria Hall, Hanley ; January 15
Liverpool, Philharmonic Hall ; January 29
Sheffield, City Hall ; February 10
Cardiff, Sophia Gardens ; February 17
London, Central Hall, Westminster, February 19-20
Newcastle, City Hall ; March 17
Edinburgh, Usher Hall ; March 19
Dublin, Royal Dublin Society Hall ; April 15
Belfast, William Whitla Hall ; April 17

Tickets are available from various area organisers; the names of these organisers can be obtained from the Institution of Electrical Engineers, Savoy Place, W.C.2.

Flying Laboratories

Two "flying laboratories" went into service recently with the Board of Trade Civil Aviation Flying Unit. They are HS748 aircraft which have been fitted with the latest flight inspection equipment. This equipment will be used to check to high standards of accuracy the ground navigational aids used by civil aircraft. The use of these aids is a major contribution to safety in the air, particularly in poor weather conditions. The growth of air traffic demands more aids to navigation, to ensure that aircraft maintain regularity and correct separation.

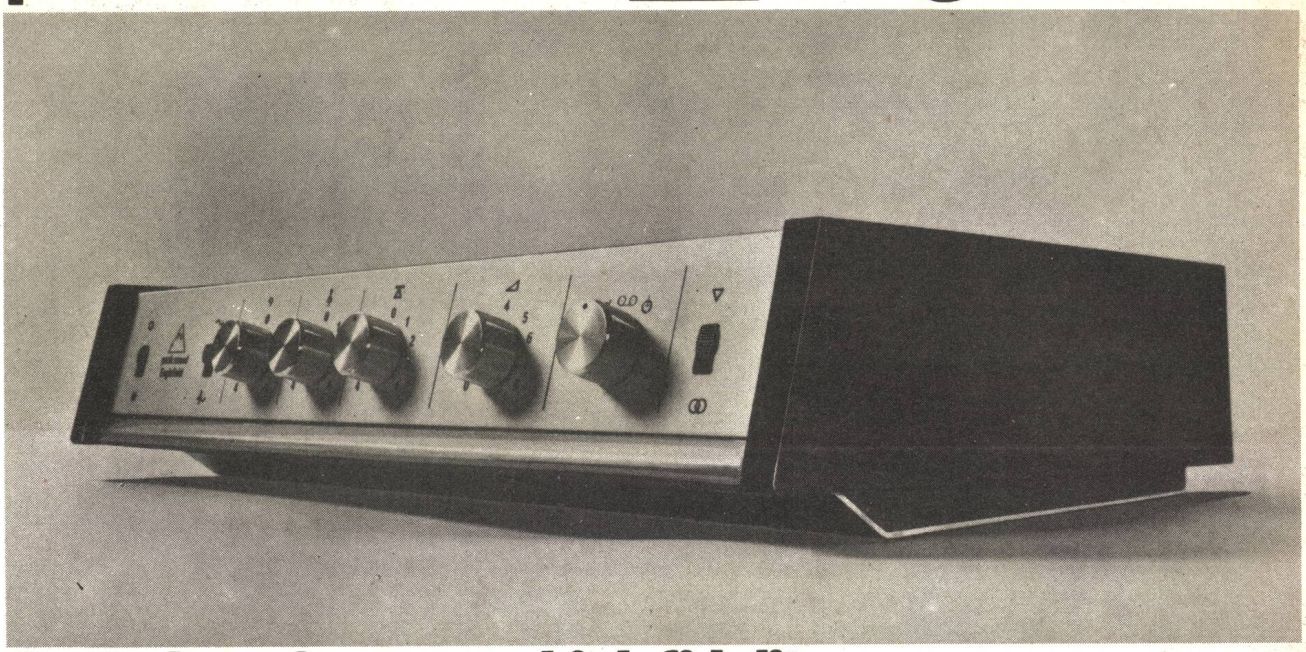
Accepting the aircraft from Hawker Siddeley Aviation at Stansted Airport, Mr Goronwy Roberts, M.P., Minister of State, Board of Trade, said the work of the Unit was vital in the cause of air safety. The new aircraft will be used to commission and periodically check, radar and radio aids to air navigation. He instanced the increasing number of instrument landing systems being installed at United Kingdom airports to meet the latest developments in automatic approach and landing, in which Britain probably led the world.

Microcircuit Film

MULLARD have added a new 24 minute colour film called "Something Big in Microcircuits" to their library (available to interested persons from Mullard Film Library, 269 Kingston Road, Merton Park, London, S.W.19).

The film begins with a look at a typical integrated circuit and goes on to show the basic processes of manufacture of the I.C. A detailed account of actual manufacture is then shown and the film finishes with a reminder that microelectronic design and manufacture is a constantly and rapidly changing process, and although the film shows the basis of microcircuit manufacture, the actual processes used may soon be out-dated.

peak sound englefield



Proved-performance high fidelity with specification guarantee

The Peak Sound Englefield is a new system which assembles from laboratory designed modules to provide a cost-performance ratio which has never been bettered in high fidelity. Here is top-flight circuitry housed in a cabinet of elegantly original design which is both beautiful and completely practical back and front. By assembling these Peak Sound units, you can own one of the best high fidelity instruments you have ever heard or seen and all for a cost of about £38. The assembly is supplied complete down to the necessary connecting wires supplied colour coded, cut to length and stripped at the ends for soldering. You can use the Englefield Cabinet design to house either the 12 + 12 watt system similar to that published in *Practical Wireless,* or the 25 + 25 watt system as approved for the *Hi-Fi News* Twin Twenty by Reg Williamson. Go to your stockist and ask to see and hear Peak Sound equipment now or send for details.

Matching F.M. Tuners will be available very shortly.

and this is the Peak Sound Specification Guarantee

Peak Sound guarantee that their equipment meets all specifications as published by them and that these are written in the same terms as used in equipment reviews appearing in this and other leading British hi-fi journals. Audio output powers are quoted at continuous sine wave power in terms of Root Mean Square values (R.M.S.) into stated loads at stated frequencies.

THE SPECIFICATION

Using two Peak Sound PA. 12-15's, driven simultaneously at 1 KHz from 240 V. mains supply.
Output per channel: 11 watts into 15Ω: 14 watts into 8Ω *(see spec. guarantee).*
Frequency bandwidth: 10Hz to 45 KHz for 1dB at 1 watt.
Total Harmonic Distortion at 1 KHz at 10 watt into 15Ω—0·1%.
Input sensitivities: Mag. PU.3·5 mV. R.I.A.A. equalized into 68KΩ: Tape, 100mV linear into 100KΩ: Radio, 100mV linear into 100KΩ.
Overload factor: 29dB on all input channels.
Signal/noise ratio: –65dB on all inputs. Vol. control at max.
Controls: Volume, Treble, Bass, Low-pass Filter. Mono/Stereo: On/off; Balance.

THE MODULES

Englefield Amplifier Cabinet with front panel, knobs, sockets, cut and stripped wire, fuses, edge connectors, etc.	£6 0 0
Two PA. 12-15 power amp. built modules	£11 19 0
SCU/400 Pre-amp/Control module, built	£15 15 0
PS/45 Power Supply kit	£4 10 0
	£38 4 0

peak sound

To Peak Sound, 32 St. Jude's Rd., Englefield Green, Egham, Surrey
Details of Englefield systems, please and .....
.....
Name .....
Address .....
..... PE.1
Write your stockists name and address in margin below and cut out with coupon if necessary

Go to your Stockist. Peak Sound products are already available from dealers in many parts. If your own local stockist is not yet ready with the Peak Sound items you require, please send direct together with your supplier's name and address and your requirements will be dealt with without delay.

TRADE ENQUIRIES INVITED

PEAK SOUND (HARROW) LTD.,
32 St. Jude's Road, Englefield Green, Egham, Surrey
Telephone: EGHAM 5316

ELECTRONIC BROKERS

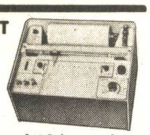
LOW COST ELECTRONIC & SCIENTIFIC EQUIPMENT AND COMPONENTS

NEW—TEST EQUIPMENT

PEN RECORDERS

Ammeter D.C. 0–2mA Single Pen—Elliott **£37.10.0**
Portable Single Pen—Record Electrical New **£49.10.0**
Quick response recorder QU/RD 15 D2 pen **£10. 0.0**
ELLIOTT single pen 5 mA FSD clockwork driven 1" per hour .. **£20. 0.0**

NEW—5 in. CHART PEN RECORDER JY100A-2



High quality single pen recorder with 0–10mV deflection. Chart speed 1 in per min. and 16 in per hour. Adjustable zero location. Power supplies 230V 50Hz. Full specification available on request. **£69.10.0.** P. & P. 30/–.

PORTABLE WHEATSTONE BRIDGE with five switched range from 0·05Ω to 50,000Ω. 2% accuracy. Price **£9.19.6.** P. & P. 10/–.

MUTUAL INDUCTANCE BOX

Ranges from 0 to 11·1mHz in 0·002 divisions. Price **£26.10.0.** P. & P. £1.0.0.

HIGH VALUE DECADE RESISTANCE BOX

Ranges from 0·01MΩ to 111MΩ. Accuracy 0·05%. Maximum Power Rating 0·1W per step. Price **£22.10.0.** P. & P. £1.0.0.

MUTUAL INDUCTANCE COIL

0·001 Hz. Accuracy 3%. Maximum current 3 amps. Price **£2.10.0.** P. & P. 7/6.
Full specification available on request.

SET OF MEASURING INSTRUMENTS

Specification Type: Moving Coil D.C. Ranges: 0–75mV, 0–3V, 3–15–150V, 3–150–450V, 0·3–0·75A, 1·5–7·5A, 15–30A. Scale Length: 82mm. Accuracy: 1·0%. Shunts: 1.0·3–0·75 amps. 2. 1·5–7·5 amps. 3. 15–30 amps. Case: Moulded plastic. Carrying Case: Stove enamelled metal. List price £30. Our price **£8.19.6.** P. & P. 30/-.

DECODER WITH 4 and 5 DIGIT READ-OUT

Can be used to construct frequency counter or Digital Voltmeter: Consists of NOR gates with amplifiers to drive digital display. 4 digit, **£19.10.0.**; 5 digit, **£25.0.0.** P. & P. £2.0.0.

MULLARD MATRIX CORE STORE STACKS

A.W. 510 5 planes 8 × 16 cores/per plane **£12. 10.0**
A.W. 511 5 planes 18 × 32 cores/per plane **£25. 0.0**
A.W. 534 20 planes 64 × 64 cores/per plane..... **£89. 10.0**
A.W. 597 8 planes 32 × 32 cores/per plane **£55. 0.0**
Single plane 40 × 25 × 4 ..... **£8. 10.0**

MODEL S7 TYPE G SELF STARTING SYNCHRONOUS MOTOR

1 RPM & 1 RPH. Complete with gearing spindle shaft ¼" dia. ¾" long. Torque 2500 grm. centimeter. **40/–** plus 3/– P. & P.

MOTORS

HYSTERESIS REVERSIBLE MOTOR

Incorporating two coils. Each coil when energised will produce opposite rotation of output shaft. 240V 60Hz. ½ r.p.m., ¾ r.p.m., 6 r.p.m. **30/–** each. P. & P. 3/–.

LOW TORQUE HYSTERESIS MOTOR MA23

Ideal for instrument chart drives. Extremely quiet, useful in areas where ambient noise levels are low. High starting torque enables relative high inertia loads to be driven up to 60Z/in. Available in the following speeds and ranges: 240V 50Hz, 15 r.p.m., 4 r.p.m., 2 r.p.m., 1½ r.p.m., 1 r.p.m., ¾ r.p.m., ¼ r.p.m., 1/3 r.p.m., 1/5 r.p.m., 1/6 r.p.m., 1/10 r.p.m., 1/12 r.p.m., 1/40 r.p.m., 1/60 r.p.m., 1/75 r.p.m., 1/120 r.p.m., 1/180 r.p.m., 1/360 r.p.m., 1/720 r.p.m., 1/14400 r.p.m., 1/2880 r.p.m.; 120V 50Hz, 1/6 r.p.m., 1/5 r.p.m., 1/15 r.p.m., 1/16 r.p.m., 1/20 r.p.m., 1/30 r.p.m., 1/60 r.p.m., 1/120 r.p.m., 1/240 r.p.m., 1/300 r.p.m. **25/-** each.

HYSTERESIS CLUTCH MOTOR

With integral clutch allowing the motor to drop out of engagement with the gear train, thereby facilitating easy resetting when used in timers or in conjunction with a light spring. 6 oz torque at 1 r.p.m. 240V, 50c/s. L = left, R = right. 15 r.p.m. L, 8 r.p.m R and L, 6 r.p.m. L. 4 r.p.m., ½, ¾, ¼ r.p.m. L, 1/5 r.p.m., 1/6 r.p.m., R and L, 1/10 r.p.m., 1/12, 1/15 r.p.m. L. Also 120V 50c/s 2, 1/6, 1/12, 5/12, 4/11, 1/10 r.p.m. **25/–**. P. 3/–.

MINIATURE DIGITAL DISPLAY

Operates on a rear projection 6·3 pilot lamp. The lamp projects the corresponding digit on the condensing lens through a projector lens, on to the viewing screen at the front of the unit. 1in width. 3 5/16 in deep. 1 5/16 in high. Weight 3½oz. Character size ⅝in high, 0·9 with 8 right hand decimal point and degree. List price 6 gns. Our price **49/6.** P. & P. 5/–.

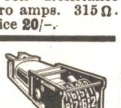
EAC DIGIVISOR Mk. II DIGITAL READ-OUT DISPLAY

Ideally suitable for use in conjunction with transistorised decade counting devices. The DIGIVISOR incorporates a moving coil movement which moves a translucent scale through an optical system and the resultant single plane image is projected on a screen. The translucent scale is made to represent digits 0–9. Specifications: 6·3V 250 microamp. Image height ¾in. Size 4 9/16 × 2 39/64 × 1⅛in. **Our price 3⅓ gns.** List price 8½ gns.

MINIATURE MOVING COIL RELAY S115

By Sangamo Weston, suitable for D.C. circuit. A high sensitivity relay more sensitive than the electromagnetic type. Single Coil Resistance 310 micro amps. 315Ω. List price £4.10. Our price **20/–.**

ELECTRO MAGNETIC COUNTER



Slow impulse counter of 10 impulses per second. **6/6.** P. & P. 3/–.

6 DIGIT ELECTRICAL IMPULSE COUNTER with electrical and mechanical reset counter driven by 110 V DC 4400 ohms coil. Reset 110 V DC 800 ohms coil. Housed in plastic-alloy case. The units can be interlocked with each other to give vertical or horizontal displays. Price **79/6.** P. & P. 5/-.

REPEAT CYCLE TIMERS

These timers repeat a set cycle of switching operations via a cam and micro switch, for as long as the motor is energised. Single Cam RB 21in 2 min, 3 min, 4 min, 5 min, 6 min, cycles at **45/–**. Twin Cam RD 22 in 1 min, 2 min, 3 min, 4 min, 5 min cycles at **55/–**. 4 Cam RD 24 in 4 min, and 5 min cycles at **75/–**. 3 Cam RD 26 in 1 min, 2 min, 3 min, 4 min, 5 min cycles at **95/–**. 8 Cam RD 28in 1 min, 2 min, 3 min, 4 min, 5 min, cycles at **115/–**. All plus P. & P. 5/–.

AVO SIGNAL GENERATOR

Frequency Range 50kc/s–80Mc/s. Output 0·5V. Price **£15.** Carriage £1.10.

Low ohm safety meter 12mA 5 ohms. Suitable for testing circuits where currents must be limited. W/N and P/E. **£12.10.0.** P. and P. 17/6.

ADVANCE TRANSISTORISED DC POWER UNITS

	Input Volts		*Output Volts*	*Amps*	*Price*
DC 4	200–245 ± 15%		12	4	**£17.10**

LEDEX ROTARY SWITCHES (New)

N.S.F. wafer switches driven by 24V or 48V d.c. motor. Ideal where switching is to be controlled by a signal pulse. Following sizes available: 2E—3 wafers, 1 pole, 12 position per wafer. 3E—1 wafer, 1 pole, 12 pole per wafer. **35/–** each. P. & P. 3/6.
3E—Tandem Drive 12 wafers—**70/–**. P. & P. 5/–.
2E—twin mounted 4 wafer Ex Equip. **60/–**. P. & P. 5/–.

DC TACHO GENERATOR

11 Miscl. Size 11. 400 cycles, 115v. input, 0.5v/1000 r.p.m. **£15.** P. & P. 5/-.

SERVO MOTORS

11M. 10EZ. Size11. 400 cycles. Ref/Control: 115/40v. Torque 20 oz per inch. Speed 5,600 **£12.10.0.** P. & P. 5/-.
Size 18. 400 cycles, 115/115v. 2.35 oz per inch. 4,800 r.p.m. **£12.10.0.** P. & P. 5/-.

SYNCHRO TORQUE TX.

11 TX. 4B. Synchro Torque Transmitter. 400 cycles. Ref/Control: 115/90v. **£9.10.0.** P. & P. 5/-.

SYNCHRO CONTROL TX/TRANSFORMER

15 CX/CT 4 8L. 400 cycles. Ref/Control: 115/15v. 1.4v. per degree. **£15.** P. & P. 5/-.

★ HIGH PRECISION ★ FULLY STABILISED TRANSISTORISED LOW VOLTAGE POWER SUPPLIES

incorporating
* S.C.R. Panel for overload projection.
* OVERLOAD & CIRCUIT BREAKER WITH MANUALS RESET button.
* RIPPLE belter, better than 3000: 1.
* CHOKE OF CAPACITOR transistorised 120/130V A.C. INPUT.

Available in the following types:

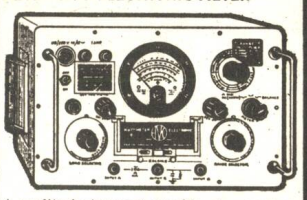
6V 12 amp	**£17.10.0**
6V 16 amp	**£22.10.0**
12V 8 amp	**£22.10.0**
12V 16 amp	**£25. 0.0**
12V 22 amp	**£25. 0.0**
20V 16 amp	**£25. 0.0**
24V 4 amp	**£22.10.0**
30V 8 amp	**£18.10.0**
56V 7 amp	**£25. 0.0**

Ex-equipment but fully tested in our laboratory. Carr. 30/–

POCKET CALCULATOR

Save time and solve all your multiplication, division, percentage, cube and square root problems. Easy to use pocket calculator with no errors. Invaluable daily aid, should last a lifetime, offered complete in black wallet with full instructions, 3¼in diam. **12/6** each, P. & P. 1/6.

NEW—AVO ELECTRONIC METER



A quality instrument capable of measuring A.C. and D.C. voltage and current, resistance plus power output.
Ranges: D.C. voltage 250mV–10,000V. D.C. current 100uA–25A. A.C. voltage 100mV–250V, A.C. current 10u–A–25A, Resistance 0–100MΩ. Power output 50μW–5W. Supply voltage 110/200/25 50Hz.
Complete with lead and probe for RF measurement up to 250M Hz **£25.** P. & P. **£1**

METERS

Milliammeter. A.C./D C. 100MA and 200MA FSD Cambridge 47526/4 Electrodynamic **£25**
Precision Voltmeter. A.C./D.C. 0–75V: 0–150V: 0–300V Sangamo Weston S.92.1–6 **£35**
Precision Multimeter. V.I.R.W. E.I.L. Model 44 ..... **£15. 0.0**
Watt Absorption Meter. Marconi CT44 200 UW–6W **£35. 0.0**
A.F Micro Voltmeter. Dymar 703, as new..... **£45. 0.0**
V.H.F. "Q" Meter—Marconi TF886B **£45. 0.0**
Wide Band Millivoltmeter—Marconi TR1371 ..... **£35.10.0**

POTENTIOMETERS

Precision—Tinsley 5205C..... **£55. 0.0**
Precision Vernier Pot.—Cambridge **£65. 0.0**

OSCILLOSCOPES

Cossor 1035 ..... **£25. 0.0**
Cossor 1035 Mk. III **£35. 0.0**
Cossor 1049 Mk. III **£40. 0.0**
Solartron CD513.2, CD523S.2—LF and Servos, Long Persistent tube **£49.10.0**
Solartron AD557—Pulse and Radar Field **£55. 0.0**
Solartron CD711S.2—Double Beam DC.7 Meg. **£65. 0.0**
Mullard L101/3 Double Beam.. **£99.10.0**
Furzehill 0·100 ..... **£25. 0.0**
Airmec 723 ..... **£19.10.0**
Airmec 249 ..... **£25. 0.0**
PHILIPS 3230 D.B. 0–10 M Hz **£85. 0.0**
SOLATRON Portable D.B. 104 0–5 M Hz **£80. 0.0**

VEEDER ROOT 6 DIGIT COUNTER

Suitable for counting all kinds of production runs, business machine operation. Mechanically driven. Reset type KA 1337, manual knob. Ex-equipt. but new condition. Special price **25/–** plus 5/– P. & P.

OSCILLATORS

Automic L.F. Sweep Oscillator Dawe 444C New **£89.10.0**
Wide Band Oscillator Dawe 400C **£35.10.0**

CONTINUOUS TAPE CASSETTE

Suitable for sleeping, learning, teaching programmes. Programming machine tools, telephone answering, etc. Complete with replay/record head and separate erase head. ¼in. tape, twin track tape. 230V 50Hz supply. Price **£3.9.6.** P. & P. 10/-.

SINGLE SPEED TAPE DECK

Driven by 240v 50 Hz power supply. Speed 3¾in. per sec. Remote control operation, 3 motors, record/replay heads with separate erase head. Fast erase facilities and counter, ¼in. track. Price **£2.19.6.** P. & P. 20/-.

MEMORY CORE STORES

42 × 52 2K bit ferrite core store complete with 84 OA 10 load diodes. Ideal for building computer store or holding information in binary form. Price **£4.10.0.** P. & P. 6/-.

MINIATURE SQUARE COUNTER 6 DIGIT

by Veeder Root. Rotary ratchet type, adds 1 count for each 36° movement of shaft **9/6** + 2/6 P. & P.

ELECTRONIC BROKERS LTD., 49-53 PANCRAS RD., LONDON, N.W.1 Tel. 01-837 7781/2 Cables: SELELECTRO

CARRIAGE EXTRA

Report from AMERICA

BY L. HUGGARD B.Sc.

... HAMFEST ... AND VARACTORS ...

A "HAMFEST" in the United States is a get together of radio amateurs to trade equipment and parts, and of course to consume beer. The Cincinnati "Hamfest" is a traditional happening which has been growing successfully for over 30 years, as the 20 year holder of the presidency happily assured me. By mid afternoon the previous year's gate of just over 2,000 had been comfortably exceeded.

It is organised by the Greater Cincinnati Amateur Radio Association who charge five dollars admission, extracted under a large sign saying "Flea Market!" The admission ticket is a passport to unlimited free beer, two substantial picnic meals and various other snacks, and the ticket number is entered in the hourly prize draws throughout the day.

OPEN MARKET

The wheeling and dealing is conducted by the amateurs round the open boots of their cars packed into a picnic ground taken over for the day, on the outskirts of the city. Here the unwanted junk of the previous year, bearing a hoped for price with occasionally an exhortation to "Fight Poverty, Buy Something" competes with the somewhat more professionally displayed wares of the Government surplus and surplus components dealers, whilst some new equipment manufacturers trade from the grandeur of the bad weather shelter.

The goodies on display defy cataloguing, and ranged in price from thousand dollar brand new transmitter receivers with digit frequency readout to new transistors at two cents each. There were amateur built pieces of equipment. There were old scopes with indignant spiders busily repairing their disturbed webs amongst the tubes. There were early post World War One service radio equipment and even older devices.

There were cameras, lenses, air-compressors, clarinets, trumpets, and all sorts of pickings with knobs and without. Best of all were the boxes of pure junk, fitting accompaniment to another paper carton of free beer.

No matter what one wanted, in the dark corner under the spare wheel of some car, there it would be.

FUN AND GAMES

For the more frivolous there were "hunt the transmitter" games, but to play it was best to have remembered to bring a 440MHz receiver; the lazy alternative was to go and lie in the sun and watch the demonstration radio controlled model planes shave the trees.

The man in the flamingo pink cap just *had* to be an Englishman. He was. Now after nine years in this country a company vice president and operator of station WA8QXU, which he assured me could be heard in Britain.

The prize draw in the late afternoon was the final adrenalin raiser, after which for many inexperienced salesmen came the awful decision, to dump it or try and sneak it back past the wife's eagle eye to the basement for another year.

VARIABLE CAPACITANCE DIODES

For many applications the mechanical variable capacitor is doomed to extinction. Those splendid rows of shining plates on ball bearing spindles, so much a part of radio, will disappear, to be replaced by the Variable Capacitance Diode or "Varactor".

Plastic encapsulated varactors are now being introduced at consumer prices. High capacitance devices which could be substituted for a couple of hundred puffs tuning capacitor are still relatively more costly. Prices are coming down and this state is unlikely to last.

The capacitance effect in the diode is due to the depletion layer formed at the junction of the *p* and *n* type materials forming it. The depletion layer can be looked upon as an electrically neutral area, exhibiting a high resistance because of the lack of conduction carriers.

The diode thus resembles a simple parallel plate capacitor, the *p* type material being one plate and the *n* type the other, separated by the dielectric, the depletion layer. The width of the depletion layer, and thus the distance apart of the "plates" can be varied by varying a reverse bias voltage applied across the junction.

Varactors can be obtained with nominal capacitances of up to 250pF and a tuning range of ten-to-one. These are more expensive than lower values with reduced range.

TUNING RATIO

The tuning ratio is the ratio of the capacitance at the lower reverse bias voltage to that at the upper reverse bias voltage.

$$\text{TR (tuning ratio)} = \frac{C_2}{C_{10}}$$

where C_2 = Capacitance at 2V reverse bias.
and C_{10} = Capacitance at 10V reverse bias.

The reverse voltage cannot be increased indefinitely or the junction will break down at too high a value.

A PRACTICAL EXAMPLE

A typical tuning application is shown in Fig. 1. Note that the inductor L is in parallel with the series combination of C and C_d, where C_d is the varactor capacitance.

C is made very much larger than C_d so that its effect on the resonant frequency of the circuit is negligible and that frequency is given by

$$f = \frac{1}{2\pi\sqrt{LC_d}}$$

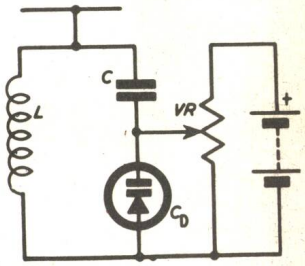


Fig. 1. Note that diode is reverse biased by potentiometer VR

C blocks the bias voltage from the coil, which would otherwise provide a low resistance path for bias currents, reducing the voltage across the varactor. VR can be large, about 470 kilohms, so that the bias circuit loading of the tuned circuit is small.

The reverse resistance of the diode is large and virtually the whole of the voltage picked off the potentiometer VR appears across the tuning diode. The circuit is thus tuned by varying the setting of the potentiometer. There is one snag, the maximum signal appearing across the tuned circuit must be much smaller than the minimum bias voltage applied to the diode or serious intermodulation distortion will result.

An obvious use for such a circuit is to permit tuning by remote control, and the ingenious can carry on from there.

EDUCATED EMMA

ELECTRONIC MIME MOBILE ANIMAL

By G.C.BROWN
M.S.H.A.A. A.M.R.S.H.

This article is an extension of the EMMA project published in the March and April 1969 PRACTICAL ELECTRONICS. It is expected that readers wishing to add EMMA's new capability will be familiar with the previous articles; the component numbering is carried on from the earlier circuits and reference is made to diagrams in the March and April 1969 issues. We regret that we are no longer able to supply copies of these issues.

SINCE the formative weeks following EMMA's rather difficult birth back in March she has, as we would have expected, already come of age. Indeed, she now exhibits a kind of self-preservation awareness which encourages her to perform simple work tasks for a living. More accurately, given the right situation EMMA really "wants" to work because to do so is now part of her make-up and she can learn that quite often this will pay-off.

In order to embody this new faculty EMMA's shape has filled out just a little with an additional circuit board. However, the modifications to her existing systems are not unduly complicated and the keen Bionics constructor will probably be overjoyed to know that at last he can have a semi-intelligent "animal".

ANATOMICAL CHANGES

To encourage EMMA to work in return for reward requires a few extra circuit blocks and if the reader refers to Fig. 1, a clear impression of the technique will be gained.

The philosophy behind the original scheme for EMMA has not been changed drastically, but there are now included such items as a Schmitt trigger which monitors the supply voltage level and of course the inevitable learning circuit with which by now we must all be familiar. This embodies a pair of monostables, one (the extension monostable) having a duration of 20 seconds and the other (the differential monostable) a period of 1 second.

As usual there are also included an AND gate and a summer with its attendant learnt threshold Schmitt which triggers upon the summer level reaching some pre-determined value.

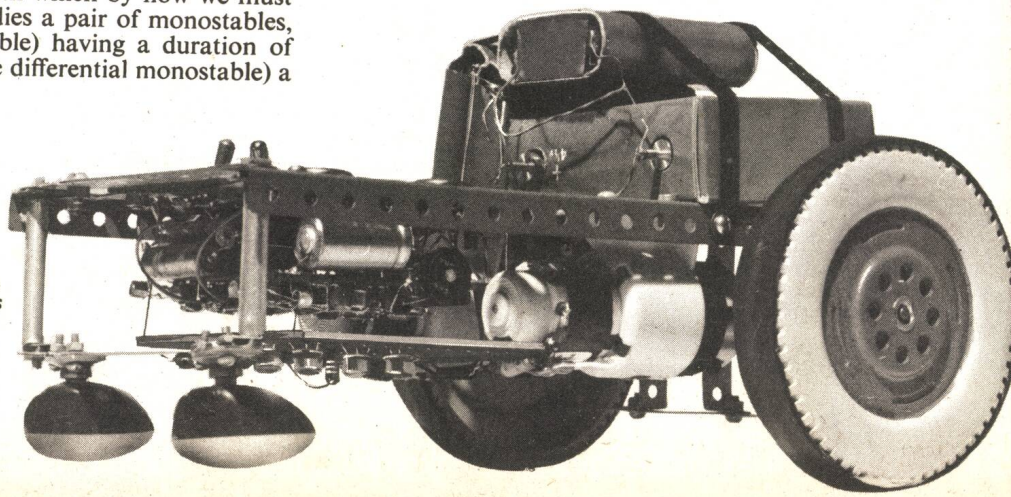
DESIGN PHILOSOPHY

Now it is intended that EMMA should learn to work, so this implies that she must additionally have a need to work in the first place. If a situation is made sufficiently attractive she will be prepared to do some simple chore provided she has a previous memory of being rewarded.

These requirements are largely accommodated by deliberately reducing EMMA's muscle control supply for short periods. This makes her hypersensitive to loads during which she is encouraged to carry a heavy book or similar object.

Periodically we may give her some "reward" by returning the supply to normal so that she realises that we intend to pay her when the work has been done.

We achieve all this in a somewhat synthetic way by switching out one of the cells forming part of the forward drive supply battery. Thus during conditioning her supply for the forward mode is a little less than 3 volts unless we provide a reward, in which case it rises to about 4·5V.



Complete "Educated EMMA", now with three circuit boards

4/- brings you a mountain of components at manufacturers' prices

The serious amateur should never be without this comprehensive price list and guide to semiconductors and electronic components from RCA, IR, SGS, Emihus, Semitron, Keyswitch, Plessey, Morganite, Litesold and others (together with manufacturers' application data) which you can buy direct from us at *manufacturers' prices* e.g. **IN914 *1/3d.*** ☐ **IN916 *1/11d.*** ☐ **2N697 *4/5d.*** ☐ **2N706 *2/3d.*** ☐ **2N706A *2/9d.*** ☐ **2N929 *5/8d.*** ☐ **2N1613 *4/8d.*** ☐ **2N3011 *9/1d.*** ☐ **2N3053 *6/2d.*** ☐ **2N3055 *15/9d.*** ☐ **3N140 *15/3d.*** ☐ **BFY50 *4/8d.*** ☐ **BFY51 *3/9d.*** ☐ **BSY27 *18/-*** ☐ **BSY95A *3/3d.*** ☐ **C407 *4/6d.*** ☐ **CA3012 *18/3d.*** ☐ **CA3014 *25/6d.*** ☐ **CA3020 *25/9d.*** ☐ **OA200 *1/9d.*** ☐ **OA202 *1/11d.***

Build the NEW Mainline Audio Amplifier kits – UP TO 70 WATTS

The result of the combined resources of SGS and RCA, these quasi circuits set new standards in quality and performance. Each kit is complete with circuit diagram, all semiconductors, resistors, capacitors and printed circuit board.

12A	**£7. 0. 0.**
25A	**£8. 5. 0.**
40A	**£9. 0. 0.**
70A	**£10.10. 0.**

Any two will make an outstanding stereo equipment.

To: Mainline Electronics Limited, Thames Avenue, Windsor, Berkshire

I enclose 4/-. Please send me your price list and guide ☐

I am interested in ..... Amp Mainline Audio Amplifier Kits. Please send me full data ☐

I am interested in receiving data on preamplifier & power supply kits ☐

NAME_____ ADDRESS_____

_____

(A member of the ECS Group of Companies) PE 170

DE LUXE PLAYERS

PORTABLE CABINET As illustrated. To fit standard player or autochanger. **75/-**
RCS AMPLIFIER 3 WATT. Ready made and tested. This is a 2-stage unit using a triode pentode condenser coupled valve, giving 3 watts output into a 3 ohm loudspeaker.
Tone and volume controls mounted on panel. Supplied with knobs, loudspeaker and valves UCL82, UY85. Frequency response 50-12,000 cps. Sensitivity 200mV **59/6**
Post 5/6 each item

AUTOCHANGERS	MONO
Balfour Princess	£5.5.6
BSR Superslim UA25	£6.19.6
BSR Mini Changer	£8.19.6
AUTOCHANGERS	STEREO
BSR Superslim	£7.19.6
Garrard 1025	£7.19.6
Garrard 3000	£12.19.6
SINGLE PLAYERS	MONO
EMI Junior Mains	£2.19.6
Garrard SRP22 ...	£6.19.6
SINGLE PLAYER	STEREO
Garrard SP25 MkII	£12.19.6

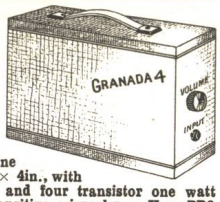
GARRARD TEAKWOOD BASE WB.1. Ready cut out for mounting 1025, 3000, SP25, AT60, etc. **65/-**
GARRARD PLASTIC COVER SPC.1 for WB.1 BASE. Durable tinted attractive appearance. **65/-**

E.M.I. PICK-UP ARM. Complete with mono cartridge 29/6; XTAL GP67 17/6; Stereo Ceramic 35/-. ACOS LP only 10/6

CRYSTAL MIKE INSERTS

1½" dia. 6/6: ACOS 1½" dia. 12/6. BM3, 1" dia. 9/6
QUALITY RIBBON MIKE WITH GOOSENECK £11.11.0
CRYSTAL HAND MIKE, HIGH OUTPUT 12/6

PORTABLE TRANSISTOR AMPLIFIER PLUS DYNAMIC MICROPHONE



A self-contained fully portable mini p.a. system. Many uses — ideal for Parties, or as a Baby Alarm, Intercom, Telephone or Record Player Amplifier, etc. Attractive rexine covered cabinet, size 12 × 9 × 4in., with powerful 7 × 4in. speaker and four transistor one watt power amplifier plus ultra sensitive microphone. Uses PP9 battery. Brand new in Makers' carton with full makers' guarantee. World famous make. Only **90/-** Post Free

WEYRAD P50 — TRANSISTOR COILS

RA2W 6 in. Ferrite Aerial with car aerial coil 12/6	Spare Cores ..... 6d.
Osc. P50/1AC 5/4	Driver Trans. LFDT4 .. 9/6
I.F. P50/2CC 470 kc/s .. 5/7	Printed Circuit, PCA1 .. 9/6
3rd I.F. P50/3CC 6/-	J.B. Tuning Gang 10/6
Telescopic Chrome Aerials 6in. extends to 23in. 5/-.	Weyrad Booklet 2/-
Ferrite Rods Only 8 × ⅜in. 4/-. 6 × ½in. 5/-.	

VOLUME CONTROLS

Long spindles. Midget Size 5 K. ohms to 2 Meg. LOG or LIN. L/S 3/-. D.P. 5/-
STEREO L/S 10/6, D.P. 14/6
Edge 5K. S.P. Transistor, 5/-.

80ohm Coax 8d. yd.

BRITISH AERIALITE
AERAXIAL-AIR SPACED
40 yd. 20/-; 60 yd. 30/-.
FRINGE LOW LOSS Ideal 625 lines **1/6** yd.

WIRE-WOUND 3-WATT POTS. T.V. Type. Knurled Knob. Values 10 Ω to 30 K., Carbon 30 K to 2 meg. **4/6**
WIRE-WOUND 3-WATT STANDARD SIZE POTS. LONG SPINDLE 10 OHMS to 100 K. **7/6**

VEROBOARD 0·15 MATRIX

2½ × 5in. 3/8. 2½ × 3⅞in. 3/2. 3¾ × 3⅞in. 3/8. 3¾ × 5in. 5/2.
EDGE CONNECTORS 16 way 5/-; 24 way 7/6.
PINS 36 per packet 3/4. FACE CUTTERS 7/6.
S.R.B.P. Board 0·15 MATRIX 2½in. wide 6d. per 1in., 3¾in. wide 9d. per 1in.; 5in. wide 1/- per 1in. (up to 17in.).
S.R.B.P. undrilled ⅛in. Board 10 × 8in. 3/-.

BLANK ALUMINIUM CHASSIS. 18 s.w.g. 2½in. sides, 7×4in., 5/6; 9×7in., 6/6; 11×3in., 6/6; 11×7in. 7/6; 13×9in., 9/6; 14×11in., 12/6; 15×14in., 15/-.
ALUMINIUM PANELS 18 s.w.g. 12×12in. 6/6; 14×9in. 5/6; 12×8in. 4/6; 10×7in. 3/6; 8×6in. 2/6; 6×4in. 1/6.

Q MAX CHASSIS CUTTER

Complete: a die, a punch, an Allen screw and key
⅛in. 16/- ¼in. 17/6 1¼in. 19/6 1½in. 24/- 2⅜in. 44/3
⅛in. 16/- 1in. 19/6 1¼in. 20/6 1½in. 29/- 2⅝in. 57/3
⅛in. 16/9 1⅛in. 19/6 1¼in. 21/6 2in. 39/- 1in. sq. 36/6

1¼inch DIAMETER WAVE-CHANGE SWITCHES.
2 p. 2-way, or 2 p. 6-way, or 3 p. 4-way 4/6 each.
1 p. 12-way, or 4 p. 2-way, or 4 p. 3-way, 4/6 each.
1 inch DIAMETER Wavechange "MAKITS" 1 p. 12-way, 2 p. 6-way, 3 p. 4-way, 4 p. 3-way, 6 p. 2-way, 1 wafer 12/-, 2 wafer 18/-, 3 wafer 24/-, 4 wafer 30/-, 5 wafer 36/-.
TOGGLE SWITCHES, sp. 2/6; sp. dt. 3/6; dp. 3/6; dp. dt. 4/6

ALL PURPOSE HEADPHONES

H.R. HEADPHONES 2000 ohms Super Sensitive ..	35/-
LOW RESISTANCE HEADPHONES 3-5 ohms	39/6
DE LUXE PADDED STEREO PHONES 8 ohms ..	79/6

"THE INSTANT" BULK TAPE ERASER AND RECORDING HEAD DEMAGNETISER

200/250 v. A.C. Leaflet S.A.E. Post 2/6 **42/6**

BARGAIN STEREO/MONO SYSTEM

Attractive Slim PLAYER CABINET with B.S.R. Stereo Autochanger, 3 VALVE STEREO AMPLIFIER, two 6½ in. LOUDSPEAKERS. (Only 4 pairs of wires to join). Carr. 10/6. S.A.E. for details. **£19.19.6**

NEW TUBULAR ELECTROLYTICS		CAN TYPES	
2/350V .. 2/3	100/25V .. 2/-	8/600V .. 9/6	
4/350V .. 2/3	250/25V .. 2/6	16/600V .. 12/6	
8/450V .. 2/3	500/25V .. 4/-	16+16/500V 7/6	
16/450V .. 3/-	8+8/450V 3/6	50+50/350V 7/-	
32/450V .. 3/9	8+16/450V 3/9	60+100/350V 11/6	
25/25V .. 1/9	16+16/450V 4/3	32+32+32/350v. 8/6	
50/50V .. 2/-	32+32/350V 4/6	100+50+50/350v.9/6	

SUB-MIN. ELECTROLYTICS. 1, 2, 4, 5, 8, 16, 25, 30, 50, 100, 250mF 15V 2/-; 500, 1000mF 12V 3/6; 2000mF 25V 7/-.
CERAMIC. 500V 1pF to 0.01mF, 9d.
PAPER 350V·0·1 9d, 0·5 2/6; 1mF 3/-; 2mF 150V 3/-.
500V·0·001 to 0·05 9d; 0·1 1/-; 0·25 1/6; 0·5 3/-.
1,000V·0·001, 0·0022, 0·0047, 0·01, 0·02, 1/6; 0·047, 0·1, 2/6.
SILVER MICA. Close tolerance 1%. 5-500pF 1/-; 560-2,200pF 2/-; 2,700-5,600pF 3/6; 6,800pF-0·01, mfd 6/-; each
TWIN GANG. "0-0" 208pF+176pF, 10/6; 365pF, miniature 10/6; 500pF standard with trimmers, 12/6; 500pF midget less trimmers, 7/6; 500pF slow motion, standard 9/-; small 3-gang 500pF 19/6. Single "0" 365pF 7/6. TWIN 10/6.
SHORT WAVE. Single 10pF, 25pF, 50pF, 75pF, 100pF, 160pF, 200pF, 10/6 each.
TUNING. Solid dielectric. 100pF, 300pF, 500pF, 7/- each.
TRIMMERS. Compression 30, 50, 70pF, 1/-; 100pF 150pF, 1/3; 250pF, 1/6; 800pF, 750pF, 1/9; 1000pF, 2/6.
RECTIFIERS CONTACT COOLED ½wave 60mA 7/6; 85mA 9/6. SILICON BYZ13 6/-; BY100 10/-.
Full wave Bridge 75mA 10/-; 150mA 19/6; TV rects. 10/-.
NEON PANEL INDICATORS 250v. AC/DC Red, Amber 4/6.
RESISTORS. Preferred values, 10 ohms to 10 meg. ¼ w., ½ w., 1 w., 20% 3d.; 1½ w. 8d.; 2 w. 1/-; ½ w. 10% 6d.
HIGH STABILITY. ½ w. 1% 10 ohms to 10 meg., 2/-. Ditto 5%. Preferred values 10 ohms to 22 meg., 9d.
WIRE-WOUND RESISTORS 5 watt, 10 watt, 15 watt, 10 ohms to 100K. 2/- each; 3 watt. 0·5 ohm to 8·2 ohms. 2/-.

BRAND NEW TRANSISTORS 6/- EACH,
OC71, OC72, OC81, OC44, OC45, AF117.
MAT 100 7/9; MAT 101 8/6; MAT 120 7/9; MAT 121 8/6.

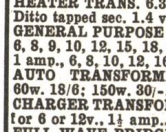
REPANCO TRANSISTOR TRANSFORMERS.
TT45. Push Pull Drive, 9:1 CT, 6/-. TT46 Output, CT8:1 6/-.
TT49. Interstage, 4·5:1, 6/-; TT52 Output 3 ohms, 20:1, 6/-.
TT23/4 PAIR 10 watt Amp. Transformers and circuit 35/-.

TRANSISTOR MAINS POWER PACKS. FULL WAVE 9 volt 500mA. Size 4½ × 2½ × 2in. Metal case. Crackle finish. Output terminals. On/off switch. **49/6**
Half Wave 9 volt 50mA. Size 2½ × 1½in. Snap terminals 32/6
9 volt 500mA. TRANSFORMER ONLY. 2½ × 1½ × 1½in. 10/6

MAINS TRANSFORMERS

	Post 5/- each
250-0-250 50 mA. 6.3 v. 2 amps, centre tapped	19/6
250-0-250 80 mA. 6.3 v. 3.5 a. 6.3 v. 1 a, or 5 v. 2 a.	30/-
350-0-350 80 mA. 6.3 v. 3.5 a. 6.3 v. 1 a, or 5 v. 2 a.	35/-
300-0-300 v. 120 mA., 6.3 v. 4 a. C.T.; 6.3 v. 2 a.	45/-
MINIATURE 200 v. 20 mA., 6.3 v. 1 a. 2½ × 2 × 1½in.	12/6
MIDGET 220 v. 45 mA., 6.3 v. 2 a. 2½ × 2½ × 2in. ..	17/6
HEATER TRANS. 6.3 v. 1½ a., 8/6; 6.3 v. 4 a.	12/6
Ditto tapped sec. 1.4 v., 2, 3, 4, 5, 6.3 v. 1½ amp. ..	12/6
GENERAL PURPOSE LOW VOLTAGE. Outputs 3, 4, 5, 6, 8, 9, 10, 12, 15, 18, 24 and 30 v. at 2 a.	30/-
1 amp., 6, 8, 10, 12, 16, 18, 20, 24, 30, 36, 40, 48 .60,	35/-
AUTO TRANSFORMERS 0-115-230 v. Input/Output, 60w. 18/6; 150w. 30/-; 500w. 92/6: 1000w. 195/-.	
CHARGER TRANSFORMERS. P.&P. 5/-. Input 200/250v. for 6 or 12v., 1½ amp., 17/6; 2 amp., 21/-; 4 amp., 30/-.	
FULL WAVE BRIDGE CHARGER RECTIFIERS: 6 or 12v. outputs. 1½ amp. 8/9; 2 amp. 11/3; 4 amp. 17/6.	

COAXIAL PLUG 1/3, PANEL SOCKETS 1/3. LINE 2/-.
OUTLET BOXES. SURFACE OR FLUSH 4/6.
BALANCED TWIN FEEDERS 1/- yd. 80 ohms or 300 ohms.
JACK SOCKET Std. open-circuit 2/6, closed circuit 4/6; Chrome Lead Socket 7/6. Phono Plugs 1/-. Phono Socket 1/-.
JACK PLUGS Std. Chrome 3/-; 3·5mm Chrome 2/6. DIN SOCKETS Chassis 3-pin 1/6; 5-pin 2/-. DIN SOCKETS Lead 3-pin 3/6; 5-pin 5/-. DIN PLUGS 3-pin 3/6; 5-pin 5/-.
VALVE HOLDERS. 9d.; CERAMIC 1/-; CANS 1/-.



T.S.L. LOUDSPEAKER CROSSOVER HLP2.

2-way crossover for 8 or 15 ohm speakers and tweeters. 3 phono input/output sockets.
Made to sell at 42/-. OUR PRICE Post 2/6. **22/6**

Tape Spools 2/6. Tape Splicer 5/-. Leader Tape 4/6.
Reuter Tape Heads for Collaro models 2 track 21/- pair.

PHOTO-ELECTRIC RELAY SYSTEM. 240v. A.C. Exciter and relay unit with infra red filter. For counting, door signals, alarms, etc. **£12** POST FREE

MINI-MODULE LOUDSPEAKER KIT

10 WATT **55/-** CARRIAGE 5/-

Triple speaker system combining on ready cut baffle. ½ in. chipboard 15 in. × 8½ in. Separate Bass, Middle and Treble loudspeakers and crossover condenser. The heavy duty 5 in. Bass Woofer unit has a low resonance cone. The Mid-Range unit is specially designed to add drive to the middle register and the tweeter recreates the top end of the musical spectrum. Total response 20-15,000 cps. Full instructions for 3 or 8 ohm.
TEAK VENEERED BOOKSHELF ENCLOSURE. 16 × 10 × 9 in. Modern Scandinavian fluted front design for Mini-Module. **94/6** Post 5/-

BAKER MAJOR £8

30-14,500 c.p.s., Hi-Fi double cone, woofer and tweeter cone together with a BAKER ceramic magnet assembly having a flux density of 14,000 gauss and a total flux of 145,000 Maxwells. Bass resonance 45 c.p.s. Rated 20 watts. Voice coils available 3 or 8 or 15 ohms. Price £8, or Module kit, 30-17,000 c.p.s. with tweeter, crossover, baffle and instructions. £10.19.6.
LOUDSPEAKER CABINET WADDING 18in wide, 2/6ft

BAKER "GROUP SOUND" SPEAKERS—POST FREE

'Group 25'	'Group 35'	'Group 50'
12in 25 watt **6gns.**	12in 35 watt **8½gns.**	15in 50 watt **18gns.**

ALL MODELS "BAKER SPEAKERS" IN STOCK

Goodmans Tweeter 3½in 3 ohm 35/-. EMI 2½in 8 ohm 17/6. Horn Tweeters 2-18kc/s, 10W 15 ohm 29/6. Crossover 16/6.
LOUDSPEAKERS P.M. 3 OHMS. 2½in, 3in, 4in, 5in, 5 × 2½in, 7 × 4in. 17/6 each; 6½in 22/6; 8 × 5in, 21/-; 8 × 2½in 21/-; 10 × 6in. 30/-; 10in. or 12in. Double cone 3 or 15 ohm 39/6.
E.M.I. Double Cone 13½ × 8in, 3 or 15 ohm 10 watt 45/-.
DITTO twin tweeters and X/over 3 or 8 or 15 ohm 10w. 79/6.
TEAK HI-FI SPEAKER ENCLOSURES. Fluted front.
For 10 or 12in dia. Loudspeaker £8.10.0.
For 13 × 8in or 8in round Loudspeaker £4.14.6.
For 10 × 6in or 6½in round Loudspeaker £3.16.6.

SPECIAL OFFER! 8 ohm, 2½in; 6 × 4in; 80 ohm. 2½in, 2½in. **15/6** EACH 25 ohm, 6 × 4in; 35 ohm, 3in TYPE 15 ohm, 7 × 4in., 8 × 5in.
8in LOUDSPEAKER UNITS 3 ohm 27/6; 15 ohm 30/-
ELAC 8 in. De Luxe Ceramic 3 ohm 45/-; 15 ohm 50/-.
8in LOUDSPEAKER. TWIN CONE 3 ohm 35/-.
5 in. WOOFER. 8 watts max. 20-10,000 cps. 8 or 15 ohm. 39/6.
OUTPUT TRANS. EL84 etc. 4/6; MIKE TRANS. 50:1 3/9.
SPEAKER COVERING MATERIALS. Samples Large S.A.E.

THE FAMOUS "MULLARD 510"

£16.19.6 Post 10/6

Main power, amplifier and 2 valve pre-amplifier. Silver grey facia panel. Volume, treble, bass controls. Function switch: Radio, Tape 1, Tape 2, Mic, Gram LP, Gram 78. Tape output socket. Valves: 2 × EL84, 3 × EF86, 1 × ECC83, 1 × EZ81. Ultra linear Parmeko output transformer. 20 db negative feedback. 10 watts rms. mono. 3 and 15 ohm output. Brand new. Guaranteed.

ALL EAGLE PRODUCTS

SUPPLIED AT LOWEST PRICES.
45-PAGE EAGLE CATALOGUE 5/-. Post free.

BARGAIN AM TUNER. Medium Wave. Transistor Superhet. Ferrite aerial. 9 volt. **79/6**

BARGAIN DE LUXE TAPE SPLICER Cuts, trims, joins for editing and repairs. With 3 blades. **17/6**

BARGAIN 4 CHANNEL TRANSISTOR MIXER. Add musical highlights and sound effects to recordings. Will mix Microphone, records, tape and tuner with separate controls into single output. 9 volt. **59/6**

BARGAIN FM TUNER 88-108 Mc/s Six Transistor. Ready built. Printed Circuit. Calibrated slide dial tuning. Size 6 × 4 × 2½in. 9 volt. **£6.19.6**

BARGAIN 3 WATT AMPLIFIER. 4 Transistor Push-Pull Ready built, with volume control. 9v. **69/6**

★ RADIO BOOKS ★ (Postage 9d.)

Practical Transistor Receivers	5/-
Practical Radio Inside Out	4/6
Supersensitive Transistor Pocket Radio	3/6
Radio Valve Guide, Books 1, 2, 3, or 4 ea. 5/- No. 5 ea.	6/-
T.V. Fault Finding 405/625 lines	8/6
Shortwave Transistor Receivers	5/-
Transistor Communication Sets	6/-
Modern Transistor Circuits for Beginners	7/6
Sub-Miniature Transistor Receivers	5/-
Wireless World Radio Valve Data	9/6
International Radio Stations Guide	2/6
Receive foreign T.V. programmes by simple modifications	5/-
Valves, Transistors and Diodes equivalents Manual...	10/6

MANUFACTURERS' SURPLUS! **25/-**
TAPE RECORDER CABINET. Grey/Red or Grey 2-tone. Rexine covered. Size 15 × 12 × 5½in. POST FREE

BRAND NEW QUALITY EXTENSION LOUDSPEAKER

Handsome plastic cabinet, 20ft. lead and adaptors. For any radio, intercom, tape recorder, etc. 3 to 15 ohm. Size: 7½" × 5½" × 3". Post 2/6 **30/-**

Minimum Post and Packing 2/6. **RETURN OF POST DESPATCH. HI-FI STOCKISTS. CUSTOMERS FREE CAR PARK. CALLERS WELCOME.**

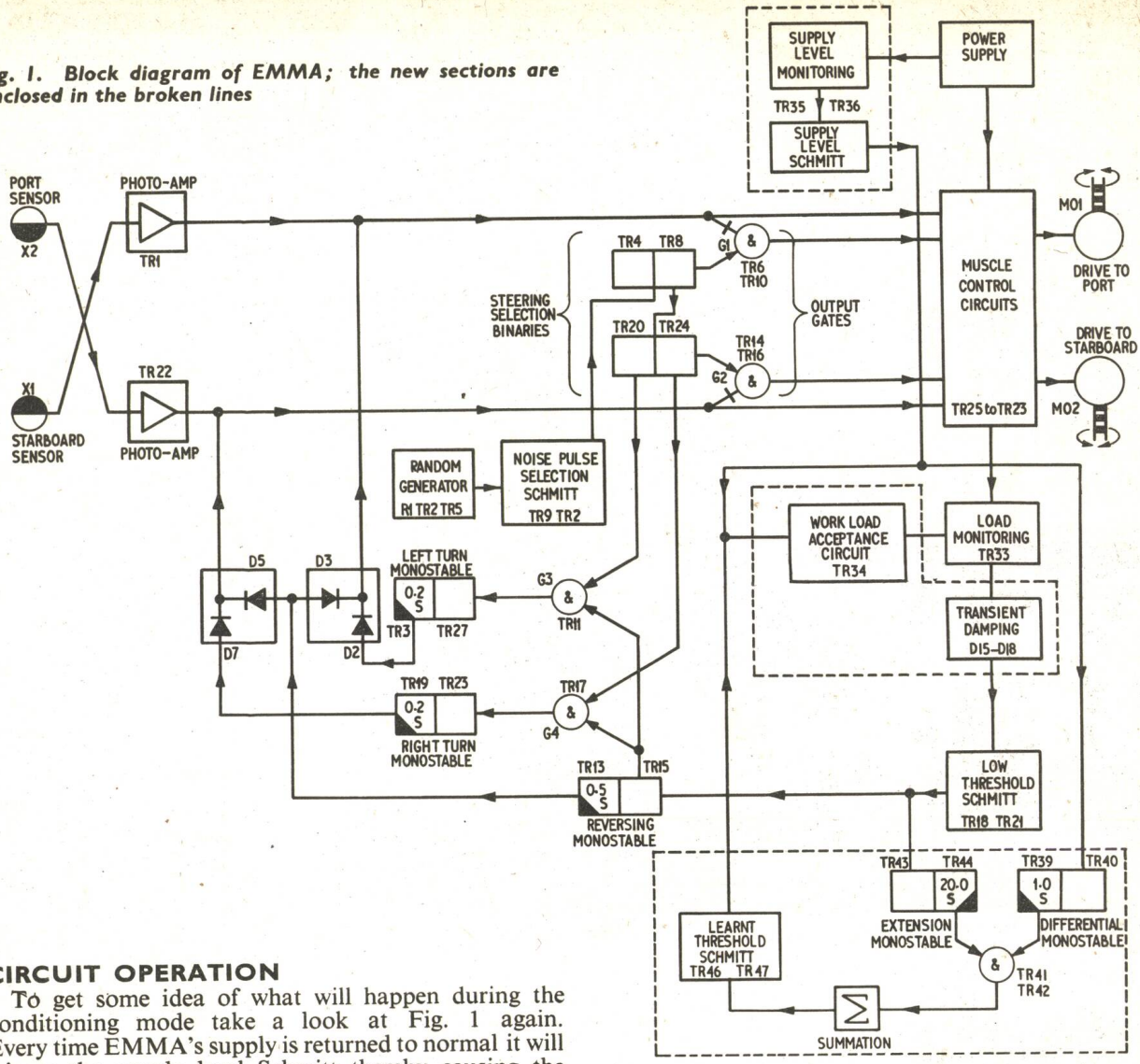
RADIO COMPONENT SPECIALISTS

337 WHITEHORSE ROAD, WEST CROYDON

Open Monday to Friday 9-6 (Wed. 1 p.m., Sat. 5 p.m.)

List 1/-. **Written guarantee with every purchase.** *(Export: Remit cash and extra postage.) Buses 133 68 pass door. S.R. Stn. Selhurst.* **Tel. 01-684 1665**

Fig. 1. Block diagram of EMMA; the new sections are enclosed in the broken lines



CIRCUIT OPERATION

To get some idea of what will happen during the conditioning mode take a look at Fig. 1 again. Every time EMMA's supply is returned to normal it will trigger the supply level Schmitt thereby causing the differential monostable to fire.

Assuming just prior to this that a physical load has been applied then the load monitoring section will have previously fired the extension monostable. As a result, and provided the differential monostable fires during the time the extension monostable is in the quasi-stable condition, the AND gate will be enabled and consequently the summer output level will begin to rise.

If we repeat the process a number of times the existence of the reward can obviously become significant because the increasing level from the summer will ultimately reach a point where the learnt threshold Schmitt fires.

Immediately this occurs the work-load acceptance circuit will raise the threshold of the load monitoring system allowing EMMA to tolerate greater loads, indeed, the very same kind of loads she would accept were her supply to be at a normal level. However, she has at this stage learnt to understand that her supply will return to normal and so she "soldiers on" in the knowledge that all will be well.

Nevertheless, if we decide to stop rewarding EMMA her memory for the "good life" will gradually diminish as the summer level falls, until a point is reached where the load will no longer be tolerated. At such times she will "twist and turn", being thoroughly intractable as her normal reflexes take over and the avoidance system goes into operation.

Like any real creature EMMA, given the opportunity, can improve her chances for continued existence by taking advantage of certain situations. Thus she can adapt herself to doing a small task if it promises some form of payment and just as easily give the job up if not adequately reimbursed.

CIRCUIT IMPROVEMENTS AND MODIFICATIONS

In her existing form EMMA will normally function quite satisfactorily and so if it is not intended to add the new circuitry her "neurology" can be left as it is. Nevertheless, there are certain improvements that can be made and certain modifications that must be attended to before adding the learning system.

The changes are all extremely simple and so will be indicated in relation to the existing circuit diagrams for the reflex and muscle control sections discussed in the March and April issues of P.E. The relevant areas of discussion are in Figs. 2 and 5, in the March and April 1969 issues respectively.

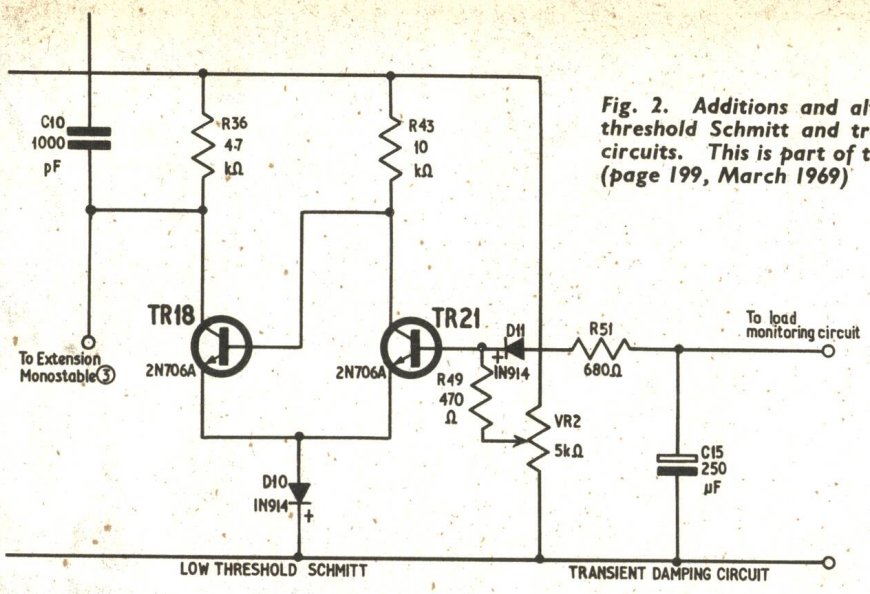


Fig. 2. Additions and alterations to low threshold Schmitt and transient damping circuits. This is part of the reflex circuits (page 199, March 1969)

TRANSIENT DAMPING CIRCUIT

In this circuit (Fig. 2, March 1969) a diode must be added (cathode end to base of TR21) in series with R51 to ensure that the voltage across C15 is entirely attributable to the output from the load monitoring system. Otherwise C15 can charge via VR2 and R49. Resistor R49 must be reduced to 470 ohms. Fig. 2 (above) shows the relevant section of the circuit.

LOW THRESHOLD SCHMITT

The resistor R40 must be removed and replaced with a diode (Fig. 2), its cathode being taken to the −4·5V rail of the "A" power supply. This modification results in there being an almost constant potential between TR18 and TR21 emitters and the negative rail. As a consequence the backlash of the Schmitt is effectively reduced to zero with the result that it comes on and goes off almost at the same point.

A connection from the low threshold circuit must also be taken from the collector of TR18; this can take the form of a short piece of insulated wire and may be coiled back out of the way until it is called upon to connect the reflex circuitry with the extension monostable discussed later.

MUSCLE CONTROL SYSTEM

In earlier articles we discussed the problem of motor noise; the "hash" was reduced using a pair of capacitors C17 and C18, across the motors (Fig. 5, April 1969). An improvement has now been embodied which really minimises the problem. This involves using a pair of 6V Zener diodes connected back-to-back (as shown in

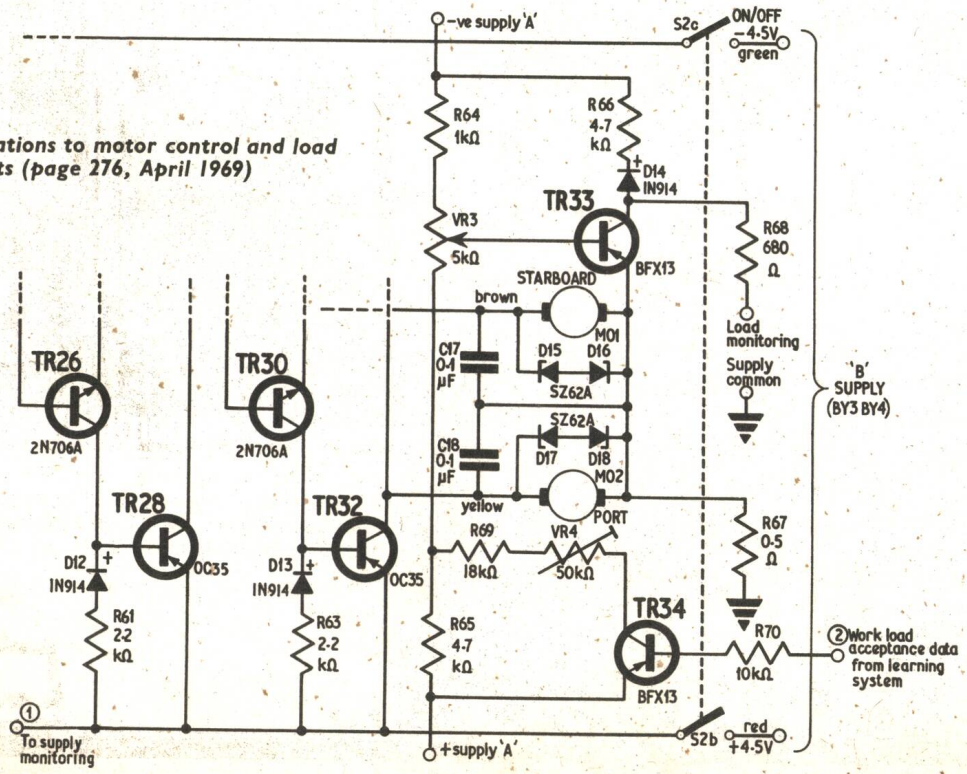
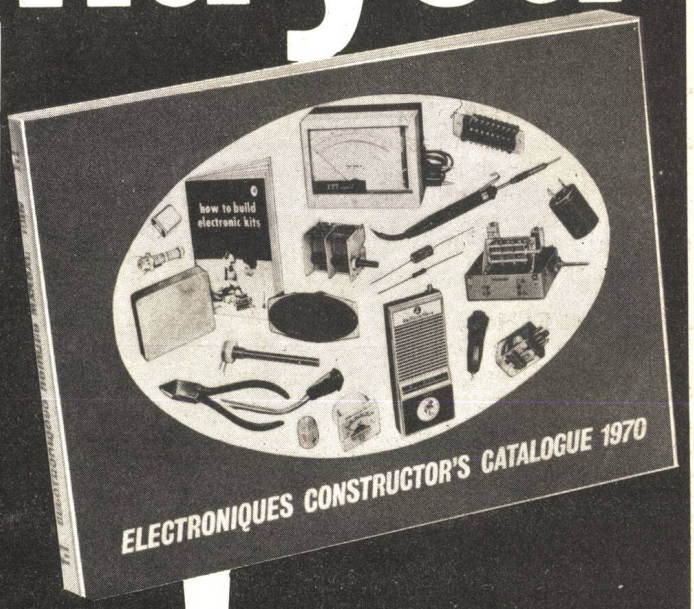


Fig. 3. Alterations to motor control and load sensing circuits (page 276, April 1969)

This book will send you mad with desire!



Don't read on unless you're feeling really strong. This book will start you on a mad, crazy spending spree.
It's got everything, but everything for the do-it-yourself radio and hi-fi man.
Everything from a vast range of electronic components available to the home electronics constructor, to a complete range of equipment for the radio "ham"
What's the book?
The Electroniques Constructors Catalogue.
Only the most exciting, mouth-watering items are there. Carefully placed in 6 sections for easy reference. And backed by truly efficient sales service.
So if you order any of the vast selection of goods, you're sure to get it pretty soon.

All you have to pay for this great big hunk of temptation is 13/- (including packaging and postage).

So fill in the coupon now. If you dare.

Enclose PO/cheque for 13/- made out to: Electroniques (proprietors Standard Telephones and Cables Limited), Edinburgh Way, Harlow, Essex. Telephone: Harlow 26811.

Name.....

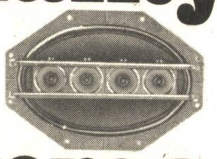
Address .....

.....

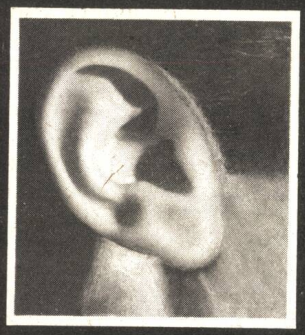
P.E.1

electroniques

How do you measure the extra quality of EMI speakers?



Listen!



EMISOUND

EMI are famous throughout the world for High Quality sound reproduction. Now our audio design engineers have developed loudspeaker systems suitable for home use.

These EMI Loudspeaker Systems, specially matched, produce every detail of the original sound over the full audio spectrum, at high and low listening levels.

They have many exclusive features. The range includes the unique 950 system with a 19 inches x 14 inches bass unit, power output 50 watts R.M.S.

Send for literature and price lists to:

EMI

EMI SOUND PRODUCTS LTD., HAYES, MIDDX. TEL: 01-573-3888 EXT. 667

TECHNICAL TRAINING

in radio television and electronics

Whether you are a newcomer to radio and electronics, or are engaged in the industry and wish to prepare for a recognized examination, ICS can further your technical knowledge and provide the specialized training so essential to success. ICS have helped thousands of ambitious men to move up into higher paid jobs—they can help you too! Why not fill in the coupon below and find out how?

Many diploma and examination courses available, including expert coaching for:

- **C. & G. Telecommunication Techns'. Certs.**
- **C. & G. Electronic Servicing**
- **R.T.E.B. Radio/T.V. Servicing Certificate**
- **Radio Amateurs' Examination**
- **P.M.G. Certs. in Radiotelegraphy**
- **General Certificate of Education, etc.**

Examination Students coached until successful

NEW SELF-BUILD RADIO COURSES

Learn as you build. You can learn both the theory and practice of valve and transistor circuits, and servicing work while building your own 5-valve receiver, transistor portable, and high-grade test instruments, incl. professional-type valve volt meter—all under expert tuition. Transistor Portable available as separate course.

POST THIS COUPON TODAY

for full details of ICS courses in Radio, T.V. and Electronics

ICS EST. 1891 **INTERNATIONAL CORRESPONDENCE SCHOOLS**

Dept. 151, Intertext House, Stewarts Rd., London, S.W.8

Please send me the ICS prospectus—free and without obligation.

(state Subject or Exam.).....

.....

NAME .....

ADDRESS .....

..... 1-70

INTERNATIONAL CORRESPONDENCE SCHOOLS

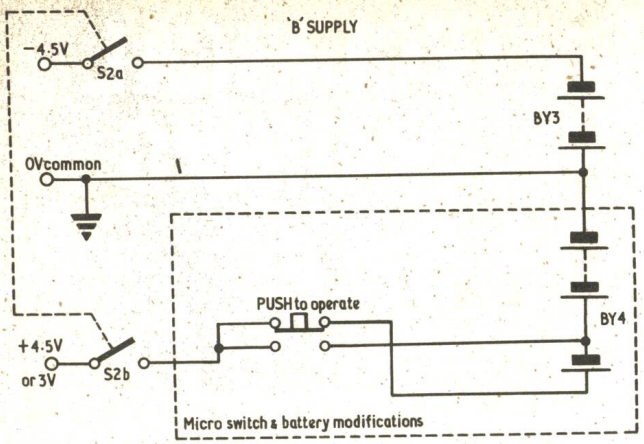


Fig. 4. Circuit diagram of the new "B" power supply and switch wiring

Fig. 3) across each motor. Noise spikes of either polarity and in excess of the Zener voltage of one diode and the forward voltage drop of the other are thus suppressed.

Additional diodes (D12 and D13) are connected in series with R61 and R63 (cathodes to the bases of TR28 and TR32 respectively) and also D14 in series with R66 (anode to collector of TR33). These are included to prevent any paths between the supply being monitored (the "forward" half of this supply) and the supply which feeds the monitoring circuit ("A" supply).

For similar reasons the load monitoring circuit is now not run from the "A" supply and suitable arrangements must be made to reconnect R64 and R66 to the negative rail of the "A" supply. The resistor R65 must go to the positive rail of the "A" supply and is shunted with the series combination R69, VR4, and TR34 (Fig. 3) which constitutes the work load acceptance circuit.

"B" POWER SUPPLY

The forward-mode battery (type 126) of the "B" supply requires a small modification so that either 3V or 4·5V may be obtained. This entails carefully opening the paper flap at the top of the battery with a razor blade and taking a connection from the 3V tapping (i.e. one cell down from the positive side of the battery). The 4·5V and 3V outputs thus obtained are then taken to a double pole changeover microswitch (Fig. 4) so that in use EMMA's forward operation can be obtained from either normal or reduced supplies.

This completes the various modifications to the existing hardware and we are now in a position to concentrate on the learning system, also to the way in which it interconnects with the rest of EMMA's person (see Fig. 5).

SUPPLY LEVEL MONITORING

This circuit comprises a Schmitt trigger which is similar in form to the type mentioned earlier (i.e. it has extremely little backlash) and has its input connected via R71 to VR5 which goes to the positive rail of the "B" supply. Adjustment of VR5 sets the threshold at which the Schmitt fires; generally this need only be just at the "B" supply level and no lower.

The capacitor between TR35 base and the negative rail of the "A" supply prevents transients switching the Schmitt.

Once set-up the Schmitt trigger will switch whenever the voltage at the positive rail of the "B" supply falls below normal (influenced by operation of the micro-switch). Hence TR35 will turn off and TR36 will come on with the result that TR37 will cease to conduct. With TR37 collector positive TR34 will turn off and consequently EMMA will be extra sensitive to loads.

When the supply is returned to normal TR35 will again turn on and TR36 will turn off. At this time the positive voltage at TR36 collector will be passed to the differential monostable causing it to fire. Simultaneously, TR37 will turn on again thereby raising the load threshold.

DIFFERENTIAL AND EXTENSION MONOSTABLES

Both monostables are a little unconventional in that they each use extra transistors forming the Darlington pairs TR38, TR39 and TR44, TR45. These provide higher gain and hence permit larger timing resistors to be used.

Diodes D22 and D23 provide a fair degree of noise immunity and so prevent the monostables from triggering prematurely if any short-term voltage drop occurs on the "A" supply. Under such conditions D22 and D23 are reverse biased and the associated capacitor (C21 or C22) effectively bridges the interval during a voltage drop "holding-up" the collector of the transistor that is turned off.

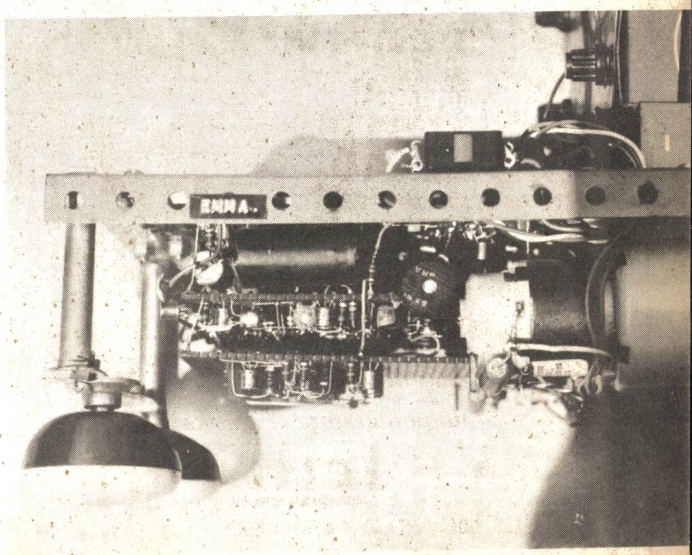
The extension monostable is triggered from the load threshold Schmitt and fires whenever the load exceeds a certain level. As mentioned earlier the differential monostable triggers whenever the positive end of the "B" supply is returned to normal.

COINCIDENCE GATE

The coincidence (AND) gate comprises TR41 and TR42. Assuming a sufficiently heavy load has been applied to EMMA then the extension monostable will have fired hence turning off TR42.

If during the 20 second period of the extension monostable the positive rail of the "B" supply has been returned from low to normal then the differential monostable will be triggered.

View of "Educated EMMA" showing the position of the new circuit board



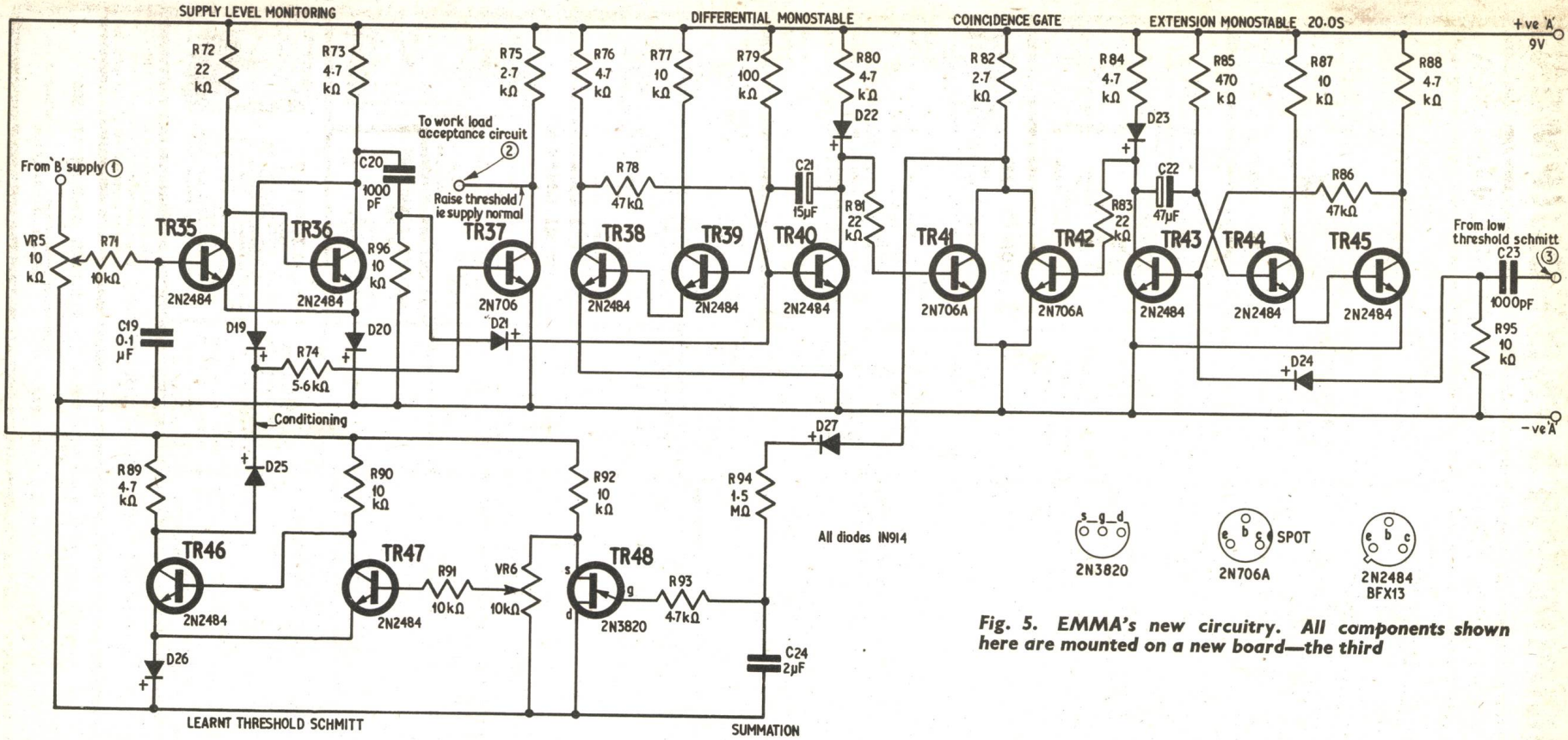


Fig. 5. EMMA's new circuitry. All components shown here are mounted on a new board—the third

COMPONENTS . . .

Resistors

R49	470Ω	R78	47kΩ	R88	4·7kΩ
R69	18kΩ	R79	100kΩ	R89	4·7kΩ
R70	10kΩ	R80	4·7kΩ	R90	10kΩ
R71	10kΩ	R81	22kΩ	R91	10kΩ
R72	22kΩ	R82	2·7kΩ	R92	10kΩ
R73	4·7kΩ	R83	22kΩ	R93	4·7kΩ
R74	5·6kΩ	R84	4·7kΩ	R94	1·5MΩ
R75	2·7kΩ	R85	470kΩ	R95	10kΩ
R76	4·7kΩ	R86	47kΩ	R96	10kΩ
R77	10kΩ	R87	10kΩ		

Potentiometers

VR4 50kΩ } skeleton preset
VR5 10kΩ }
VR6 10kΩ }

Capacitors

C19 0·1μF
C20 1,000pF
C21 15μF elect. 12V
C22 47μF elect. 12V
C23 1,000pF
C24 2μF non polarised 63V

Diodes

D10 to 14 IN914 (5 off)
D15 to 18 SZ62A or equivalent 6V Zener (4 off)
D19 to 27 IN914 (9 off)

Transistors

TR34 BFX13
TR35, 36 2N2484 (2 off)
TR37 2N706A
TR38–40 2N2484 (3 off)
TR41, 42 2N706A (2 off)
TR43–47 2N2484 (5 off)
TR48 2N3820

Miscellaneous

D.P.S.T. microswitch
Veroboard 5in × 2½in, 0·1in matrix

HR QUALITY COMPONENTS AND EQUIPMENT

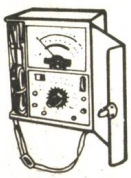
NEW RANGES FOR THE AMATEUR AND PROFESSIONAL USER

✱ QUALITY PANEL METERS

38 Series. Face size 42 × 42mm (1⅝in × 1⅛in). 50μA, 37/6; 100μA, 35/–; 200μA, 32/6; 500μA, 27/6; 1mA, 5mA, 10mA, 50mA, 100mA, 500mA, 25/– each; 10V, 20V, 50V, 100V, 300V and 500V, 25/– each; 1A and 5A, 25/– each. "S" meter, 1mA, 29/6. VU meter, 37/6.
65 Series. Face size 86 × 78mm (3⅜ × 3in). 50μA, 62/6; 100μA, 52/6; 200μA, 47/6; 500μA, 45/–; 1mA, 5mA, 10mA, 500mA, 37/6 each. "S" meter. 1mA, 42/6.
Other ranges and sizes available. List on request with full details.

✱ 50,000 OHMS PER VOLT MULTIMETER

Recommended quality instrument with mirror scale and overload protection. 0/0·3/3/12/60/120/300/600/1200V d.c. (50KμV); 0/6/30/120/300/600/1200V a.c. (10KμV); 0/30μA/6/60/300mA, 0/12A; resistance 0/10kΩ/1/10/100MΩ. Meter movement 20μA, Polarity reversing switch. Complete with batteries, leads and instructions.

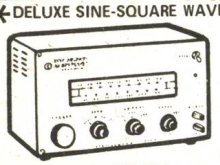


AF105 Price £8.10.0 p.p. 2/6
Leather case 28/6

✱ SINE/SQUARE WAVE AUDIO GENERATOR

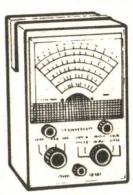
Provides audio output on 4 bands. Sine wave 20c/s to 200kc/s, output up to 7V; square wave 60c/s to 30kc/s, 7V p-p. Distortion under 2%. Output impedance 1kΩ. Variable output amplitude control. Supplied with leads and instructions. A.C. mains operated.
TE22 Price £16.10.0.

✱ DELUXE SINE-SQUARE WAVE RC AUDIO GENERATOR



Weinbridge RC Audio oscillator featuring four overlapping scales covering 18c/s to 200 Kc/s. Output waveforms are sine, square and complex. Mirrored scale with smooth geared tuning control. Output 5 volts RMS or 10 volts P-P. Sinewave response ± 1dB. Distortion under 1% at 1Kc/s. Stability ± 1%. Accuracy ± 2%. O/P Impedance under 3Kohms. Variable Attenuator. Mains operated. With Handbook.

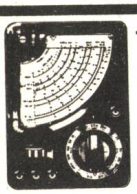
ORC 27A Price £28 10 0 pp.10/-



✱ VACUUM TUBE VOLTMETER

Features low price for such an instrument. Large 6in full view scaled meter. 28 ranges. **D.C. volts:** 0/1½/5/15/50/150/500/1500. **A.C. volts:** 0/1½/5/15/50/150/500/1500 r.m.s.: 0/1·4/4/14/40/140/400/1400/4000 p-p. **Resistance:** R × 1 0–100–1k–10k–100k–1m–10m. Range 0·2 ohm to 1000MΩ. **dB scales:** —10 to +65dB. Complete with instructions and leads.

MODEL TE65
£17.10.0 p.p. 7/6
HV Probe 50/–
R.F. Probe 42/6



✱ 20,000 OHMS PER VOLT MULTIMETER

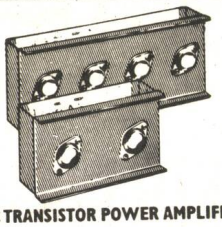
Popular model but with extra scale range. 20,000 ohms per volt. 0/5/25/50/250/500/2500V d.c., 0/10/50/100/500/1000V a.c., 0/50μA, 0/2½/250mA. Resistance 0–6kΩ and 6MΩ. Also dB scales or capacitance.

Model 200H 77/6 pp2/-
(Leather case, Price 15/- pp.2/-)

✱ PORTABLE OSCILLOSCOPE

Features 3in clear view tube, easy to use controls and good stability. Y amp. Sensitivity. ·1V p-p/CM. Bandwidth 1·5 cps—1·5 MHz. Input imp. 2 meg Ω. 25 PF. X amp sensitivity. ·9V p-p/CM. Bandwidth 1·5 cps—800 KHz. Input imp. 2 meg Ω. 20 PF. Time base. 5 ranges 10 cps—300 KHz. Synchronization. Internal / external. Illuminated scale. 140 × 215 × 330 MM. Weight 15lbs. 220/240V. A.C. Supplied brand new with handbook.

TO3 Price £35 p.p. 10/-



✱ TRANSISTOR POWER AMPLIFIERS

12 watt 3 ohm 100mV Input 24 volt supply. Model MPA 12/3 **£4.10** p.p. 3/–
12 watt 12–16 ohm 100mV Input 40 volts supply. Model MPA 12/15 **£5.5** p.p. 13/–
25 watt 8–16 ohm 180mV Input 50/60 volt supply. Model MPA 25 **£7.10** p.p. 4/6
Power Supplies 24–40 volt **90/** p.p. 3/6
50–60 volt **97/6** p.p. 4/6
Model PA7. 7 watt Amplifier 3 ohms O/P. 7mV Input, operates 12–18 volts D.C. Price **72/6** p.p. 2/6

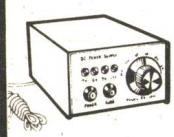
✱ 100 WATT AMPLIFIER—details on request.

✱ GRID DIP METER

All transistor grid dip meter, absorption wavemeter and osc. detector. Frequency range 440kc/s to 280Mc/s in 6 coils. Uses 3 transistors plus diode with 500μA meter. Internal battery.

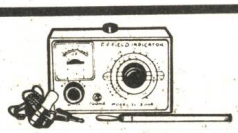
TEI5
Price .. £11.10.0
pp.3/6

✱ DC STABILISED POWER SUPPLY



Switched DC Stabilised Outputs UP TO 1AMP. 3-6-9 & 12 VOLTS. Indicator lamp for each voltage. Fully fused mains operated. Negligible ripple. Regulation 1%.

SE101A Price £8 15 0



✱ FIELD STRENGTH METER

5–Ranges 1–250 mc/s. Fitted 200μA meter. Earphone output. Calibrated tuning scales.
FL30HA Price **72/6** pp.2/-
Also non-calibrated type peaking F/S meter.. FSI Price **45/-** pp.2/6

★ TRANSISTORISED INTERCOMMS

Bellphone **£4.10.0**
2-station, **£3.10.0**; 3-station, **£5.15.0**; 4-station, **£6.12.6** (2-station uses no wires) mains operated, **£11.19.6.** Telephone amplifier, **59/6.** P. & P. 3/6

✱ SIGNAL INJECTOR

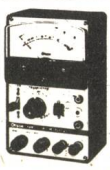
New model for checking all audio and RF up to VHF. Simple to use. Battery operated. Output approx. 1kc/s, 1·4V pp. Harmonics up to VHF.
SE250B Price **35/-** p.p. 1/6

✱ MATCHING SIGNAL TRACER
SE 500 Price 27/6 p.p. 1/6

Suppliers of quality components and equipment for over 25 years

AUDIO – HIGH FIDELITY
Complete range in stock to suit all HI-FI and Public Address requirements.

COMPONENTS
UK's largest supplier of components.
EVERYTHING YOU NEED



★ TRANSISTOR CHECKER

Complete capacity for checking all transistors *npn* and *pnp* for alpha, beta and German. Also diodes complete with leads and instructions. **ZQM-2, Price £5.19.6, p.p. 3/6.**

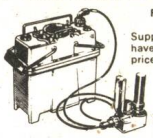
EXPERIMENTER'S MODULE

Terrific offer of brand new STC time delay electronic units. Adjustable 3–15 recs. 9–12V operated. Supplied complete with suggested uses circuits. **STC Module Price 35/–.**

9 VOLT 100 m A STABILISED SUPPLY
Size 3" x 2" x 1¼". Fused ready to use. U.K. made Transistorised.
PRICE 45/-. p.p. 2/6.

Transistors
Huge quantities in stock for Industrial users—Write for Industrial Price List. Includes all Types of Semiconductor Device.

PORTABLE GEIGER COUNTERS



FOR MEASUREMENT OF RADIO-ACTIVITY. Supplied complete with instructions haversack, cables and probe. List price £70. **OUR PRICE, NEW, TESTED** COMPLETE WITH BATTERIES **£7.10.0** POST 10/- SPARE BATTERIES 15/- PAIR. POST 5/-

DOSIMETER POCKET-TYPE 0-50r 12/6

NOMBREX

TRANSISTORISED Test Equipment

MODEL		PRICE £	s.	d.	Leaflet No.
29s	RF. Gen.	21	0	0	35
29x	Xtal RF Gen.	29	10	0	35
30	Audio Generator	19	10	0	24
31	R.F. Generator	12	10	0	25
32	C.R. Bridge	10	10	0	26
33	Inductance Bridge	20	0	0	29

STEREO HEADPHONES

Featuring soft Padded Headsets, wide frequency response. Adjustable Headbands. Fitted Jack plugs.

DHO 2/S Recommended 20C/S–15KC/S .. **£2.19.6**
SE28 Built in Tweeters and Volume Controls **£9.19.6**
KOSS, KO727 **£16.10.0.** PRO-4A .. **£23. 0.0**
SP-3KC **£11.15.0**
CALL FOR DEMONSTRATION
Mono Switched 8/16 ohms and 4K ohms Price **£4.4.0**
Stereo Headphone Amplifiers Inputs for PU/Tuner, Battery Model Mains Operated High Quality
Eagle HA10 .. .. **£8.19.6**
Shure SA2/E **£18.18.0**

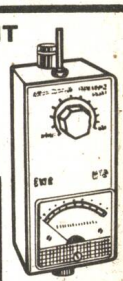
The Detector Unit consists essentially of a highly sensitive 931A photo-electric cell combined with a firing circuit. Incorporates a single cold cathode electronic relay, capacitors and resistors designed to fail to safety if external wiring is open or short circuited. Encapsulated in a resin which fully insulates the unit electrically and provides a high degree of mechanical and thermal shockproofing. Original price £74. **OUR PRICE, BRAND NEW £6 each, with data sheet**

GRAVINER FIRE DETECTOR UNIT

SIZE 4 x 3 x 2½ in.
Limited quantity available.

✱ SWR ALIGNMENT METER

Ideal for all transmitter alignment. Built-in field strength meter 100μA. Complete. Ready to use. SWR 1:1 to 1:3.
SWR 3 .. Price 69/6
p.p. 2/6



WELLER SOLDERING IRONS

8200 Gun & Iron **59/6**
8200D PK Gun Kit .. **79/6**
ANTEX CN Iron **29/6**
ANTEX Iron Kit **42/6**

*MULTIMETER

Return of a popular model. 2000 ohms/V. 0/10/50/500/1000V a.c./d.c. 0/50μA, 0/10/250μA d.c. 0/10/100kΩ/1MΩ resistance. dB and capacitance scales. Size 5in. × 3¼in × 1¼in. Robust and easy to use. Complete with leads, batteries and instructions.

THL 33A 82/6 p.p. 2/6
Leather case Price 22/6

CATALOGUES—TWO NEW EDITIONS NOW AVAILABLE SEE BACK COVER FOR DETAILS

Did you know we stock 1,000 Transistors and Devices?
Ask for Latest FREE List (No. 36)

HENRY'S RADIO LTD.

303 & 309 Edgware Rd, London W2

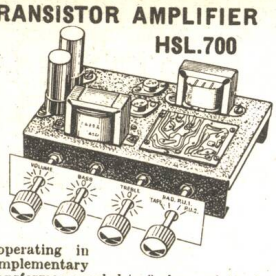
'303' Components/Equipment/Organ Parts also MAIL ORDER DEPT. 01-723-1008/9

'309' Test Gear/High Fidelity etc. 01-723 6963

ALL MAIL ORDERS TO '303'

SHOP HOURS 9 a.m.—6 p.m., THURSDAY 1 p.m.
OPEN ALL DAY SATURDAY.

MONO TRANSISTOR AMPLIFIER



A really high fidelity monaural amplifier with performance characteristics to suit the most discriminating listener. 6 transistor circuit with integrated preamplifier assembled on special printed sub panel. AD161-AD162 operating in symmetrical complementary pair. Output transformer coupled to 3 ohm and 15 ohm speaker sockets. Standard phono input sockets. Full wave bridge rectifier power supply for a.c. mains 200–240v. Controls: bass, treble, volume/on/off. Function selector for PU1, PU2, tape, radio. The HSL.700 is strongly constructed on rigid steel chassis bronze hammer enamel finish, size 9⅛ × 5 × 4¼in. high.

Sensitivity—PU1—50m/v, 56K input impedance.
PU2—110m/v, 1 meg input impedance.
Tape—110m/v, 1 meg input impedance.
Radio—110m/v, 1 meg input impedance.

Output power measured at 1Kc—6·2 watts RMS into 3 ohms, 5·8 watts RMS into 15 ohm. Overall frequency response 30c/s–18Kc/s: Continuously variable tone controls; Bass, +8db to —12db at 100c/s. Treble, +10db to —10db at 10Kc/s.

The HSL.700 has been designed for true high fidelity reproduction from radio tuner, gramophone deck and tape recorder preamp. Supplied ready built and tested, complete with knobs, attractive anodised aluminium front escutcheon panel, long spindles (can be cut to suit your housing requirements) full circuit diagram and operating instructions.

OUR SPECIAL PRICE £7.19.6. P. & P. 7/6.

LOUDSPEAKER BARGAINS

5in 3 ohm **16/-**, P. & P. 3/-. 7 × 4in 3 ohm **21/-**, P & P. 4/-. 10 × 6in 3 ohm **27/6**, P. & P. 6/-. E.M.I. 8 × 5in 3 ohm with high flux magnet **21/-**, P. & P. 4/-. E.M.I. 13½ × 8in 3 ohm with high flux ceramic magnet **42/-**, (15 ohm **45/-**), P. & P. 6/-. E.M.I. 13 × 8in, 3 or 15 ohm with two inbuilt tweeters and crossover network **4 gns**, P. & P. 6/-.

BRAND NEW. 12in 15w H/D Speakers, 3 or 15 ohm. Current production by well-known British maker. Now with Hiflux ceramic ferrobar magnet assembly **£5.10.0**, P. & P. 7/6. Guitar models: 25w **£6.0.0**. 35w **£8.0.0**.

E.M.I. 3¾in HEAVY DUTY TWEETERS. Powerful ceramic magnet. Available in 3 or 8 ohm **15/-** each; 15 ohm **18/6** each. P. & P. 2/6.

12in "RA" TWIN CONE LOUDSPEAKER. 10 watts peak handling. 3 or 15 ohm, **37/6**, P. & P. 6/-.

35 OHM SPEAKERS

3¼in **14/-**, P. & P. 2/6; 7 × 4in **21/-**, P. & P. 4/-.

30 OHM MOVING COIL SPEAKERS. High Flux Magnet 2½" dia. **12/-** each. P. & P. 1/6.

SPECIAL OFFER

Hi-Fi Celestion Speaker Unit. Size 6 x 4in. Powerful 11,000 line magnet with specially treated cone surround. 10–12 ohm impedance. Few only at 20/-. P. & P. 3/6.

QUALITY PORTABLE TAPE RECORDER CASE. Brand new. Beautifully made. Only **49/6**. P. & P. 8/6.

CRYSTAL MIKES. High imp. for desk or hand use. High sensitivity, **18/6**. P. & P. 1/6.

HIGH IMPEDANCE CRYSTAL STICK MIKES. OUR PRICE **21/-**. P. & P. 1/6.

HIGH IMPEDANCE DYNAMIC STICK MIKES. High sensitivity. **39/6**. P. & P. 2/6.

PYE MICROSWITCHES S/P. C/O. Lever roller action. Rating 250v. AC at 5 amps. Size approx. 1" × ½" × ⅜". **4/-** each. P. & P. 1/- (6 or more post free).

HONEYWELL MICROSWITCHES S/P. C/O. Push-button action. Rating 250v. AC at 15 amps. Size approx. 1⅛" × ½" × ⅝". **5/-** each. P. & P. 1/- (6 or more post free).

TELESCOPIC AERIALS WITH SWIVEL JOINT. Can be angled and rotated in any direction. 12 section Heavy Chrome. Extends from 7" to approx. 56". Maximum diameter ½". **10/-** each. P. & P. 1/6. 6 section Lacquered Brass. Extends from 6" to approx. 22½". Maximum diameter ½". **5/-** each. P. & P. 1/-.

BRAND NEW MULTI-RATIO MAINS TRANSFORMERS. Giving 13 alternatives. Primary: 0-210-240V. Secondary combinations: 0-5-10-15-20-25-30-35-40-60V half wave at 1 amp or 10-0-10, 20-0-20, 30-0-30V. at 2 amps full wave. Size 3inL × 3¼inW × 3inD. Price **32/6**. P. & P. 6/-.

MAINS TRANSFORMER. For transistor power supplies. Pri. 200/240V. Sec. 9–0–9 at 500mA. **11/-**. P. & P. 2/6. Pri. 200/240V. Sec. 12–0–12 at 1 amp. **14/6**. P. & P. 2/6. Pri. 200/240V. Sec. 10–0–10 at 2 amp. **27/6**. P. & P. 3/6. Tapped Primary 200–220–240V. Sec. 21·5V at 500mA. **12/6**. P. & P. 2/6.

BRAND NEW MAINS TRANSFORMERS for Bridge Rectifier. Pri. 240v. AC Sec. 240v. at 50mA and 6·3v. at 1·5 amp. Stack size 2½ × ½ × 2½in. **10/6**. P. & P. 3/6. (Special quotations for quantities.)

BRAND NEW! PARMEKO MAINS TRANSFORMERS. Primary 110v-250v. Secondary 330–0–330v. 100mA and 6·3v. at 2 amps, 6·3v. at 2 amps and 6·3v. at 1 amp. Conservatively rated. Fully impregnated Electrostatic screen Suitable for vertical or drop through mounting. Overall size 4½ × 3½ × 3¼in. Weight 8 lb. Limited number only at **37/6**. P. & P. 8/-.

SPECIAL OFFER ! !

Your opportunity to acquire a first class HI-FI LOUDSPEAKER SYSTEM at an extremely moderate price !

Beautifully made teak finish enclosure with most attractive Tygan front. Size 16½" high × 10½" wide × 6" deep. Fitted with E.M.I. Ceramic Magnet 13" × 8" bass unit, two H.F. tweeter units and crossover. Power handling 10 watts. Available 3 or 15 ohm impedance.

OUR PRICE WHILE LIMITED STOCKS LAST 8 Gns. Carriage 10/-

TRANSISTOR STEREO 8 + 8 MK II

Now using Silicon Transistors in first five stages on each channel resulting in even lower noise level with improved sensitivity. A really first-class Hi-Fi Stereo Amplifier Kit. Uses 14 transistors giving 8 watts push pull output per channel (16W mono). Integrated pre-amp. with Bass, Treble and Volume controls. Suitable for use with Ceramic or Crystal cartridges. Output stage for any speakers from 3 to 15 ohms. Compact design, all parts supplied including drilled metal work. Cir-Kit board, attractive front panel, knobs, wire, solder, nuts, bolts—no extras to buy. Simple step by step instructions enable any constructor to build an amplifier to be proud of. Brief specification: Freq. response ±3dB. 20–20,000c/s. Bass boost approx. to +12dB. Treble cut approx. to —16dB. Negative feedback 18dB over main amp. Power requirements 25V at 0·6 amp.

PRICES: AMPLIFIER KIT **£10.10.0**; POWER PACK KIT **£3.0.0**; CABINET **£3.0.0**. All Post Free.

Also available STEREO 10+10. As above but 10 watts per channel. **PRICES:** AMPLIFIER KIT **£12**. POWER PACK KIT £3.10.0.

Circuit diagram, construction details and parts list (free with kit) **1/6**. (S.A.E.).

Official stockists of all PEAK SOUND HI-FI EQUIPMENT including the **P.W. DOUBLE 12 STEREO AMPLIFIER** as featured in Practical Wireless April, May and June issues. Component pack as specified. Total cost **£23.5.6** plus P. & P. 11/-. (Excluding metalwork, knobs, plugs and sockets and fuses.)

SPECIAL PURCHASE! E.M.I. 4-SPEED PLAYER

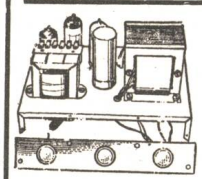
Heavy 8½in. metal turntable. Low flutter performance 200/250 V shaded motor (90 V tap). Complete with latest type lightweight pick-up arm and mono cartridge with t/o stylii for LP/78. ONLY **63/-**. P. & P. 6/6.

QUALITY RECORD PLAYER AMPLIFIER MK II

A top-quality record player amplifier employing heavy duty double wound mains transformer, ECC83, EL84, EZ80 valves. Separate Bass, Treble and Volume controls. Complete with output transformer matched for 3 ohm speaker. Size 7in. w. × 3 d. × 6 h. Ready built and tested. PRICE **75/-**. P. & P. 6/-. ALSO AVAILABLE mounted on board with output transformer and speaker ready to fit into cabinet below. PRICE **97/6**. P. & P. 7/6.

DE LUXE QUALITY PORTABLE R/P CABINET MK II

Uncut motor board size 14½ × 12in., clearance 2 in. below, 5½in. above. Will take above amplifier and any B.S.R. or GARRARD changer or Single Player (except AT60 and SP25). Size 18 × 15 × 8in. PRICE **79/6**. P. & P. 9/6.



3-VALVE AUDIO AMPLIFIER HA34 MK II

Designed for Hi-Fi reproduction of records. A.C. Mains operation. Ready built on plated heavy gauge metal chassis, size 7½in w. × 4in. d. × 4½in. h. Incorporates ECC83, EL84, EZ80 valves. Heavy duty, double wound mains transformer and output transformer matched for 3 ohm speaker. Separate volume control and now with improved wide range tone controls giving bass and treble lift and cut. Negative feedback line. Output 4½ watts. Front panel can be detached and leads extended for remote mounting of controls. Complete with knobs, valves, etc., wired and tested for only **£4.15.0**. P. & P. 6/-.

HSL "FOUR" AMPLIFIER KIT. Similar in appearance to HA34 above but employs entirely different and advanced circuitry. Complete set of parts, etc. **79/6**. P. & P. 6/-.

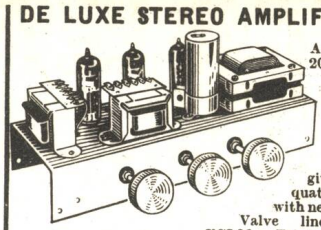
BRAND NEW TRANSISTOR BARGAINS. GET 15 (Matched Pair) **15/-**; V15/10p, **10/-**; OC71 **5/-**; OC76 **6/-**; AF117 **3/6**; 2G339 (NPN) **3/-**.

Set of Mullard 6 transistors OC44, 2—OC45, AC128D, matched pair AC128 **25/-**; ORP12 Cadmium Sulphide Cell **10/6**. All post free.

VYNAIR AND REXINE SPEAKERS AND CABINET FABRICS app. 54in. wide. Usually 35/- yd., our price 15/- yd. length. P. & P. 2/6 (min. 1 yd.). S.A.E. for samples.

POWERFUL COMPACT MOTOR for 6-9v. Battery operation approx. 25mA. Made originally for "Staar" and "Greencoat" record player decks. Built in constant speed device. Ideal for models, etc. Overall size approx. 1⅞" × 1⅞". **7/6** each. P. & P. 1/6. (3 or more Post Free).

DE LUXE STEREO AMPLIFIER



A.c. mains 200–240 volts. Using heavy duty fully isolated mains transformer with full wave rectification giving adequate smoothing with negligible hum. Valve line up:—2 × ECL86 Triode Pentodes. 1 × EZ80 as full wave rectifier. Two dual potentiometers are provided for bass and treble control, giving bass and treble boost and cut. A dual volume control is used. Balance of the left and right hand channels can be adjusted by means of a separate "balance" control fitted at the rear of the chassis. Input sensitivity is approximately 300m/v for full peak output of 4 watts per channel (8 watts mono), into 3 ohm speakers. Full negative feedback in a carefully calculated circuit, allows high volume levels to be used with negligible distortion. Supplied complete with knobs, chassis size 11in. w × 4in. x. Overall height including valves 5in. Ready built and tested to a high standard. **Price 8 gns.** P. & P. 8/-.

4-SPEED RECORD PLAYER BARGAINS

Mains models. All brand new in maker's packing.
B.S.R. UA25 with latest mono compatible cart... £6.19.6
All plus Carriage and Packing 6/6.

LATEST GARRARD MODELS. All types available 1025, 2025, SP25, 3000, AT60 etc. Send S.A.E. for Latest Prices!

PLINTH UNITS cut out for Garrard Models 1025, 2025, 2000, 3000, AT60, SP25. With transparent plastic cover. OUR PRICE **5 gns.** complete. P. & P. 8/6.

SONOTONE 9TAHC compatible Stereo Cartridge with diamond stylus **50/-**. P. & P. 2/-.

LATEST RONETTE T/O Stereo Compatible Cartridge for EP/LP/Stereo/78. **32/6**. P. & P. 2/-.

LATEST RONETTE T/O Mono Compatible Cartridge for EP/LP/78 mono or stereo records on mono equipment. **30/-**. P. & P. 2/-.

HIGH GAIN 4 TRANSISTOR PRINTED CIRCUIT AMPLIFIER KIT Type TA1

- Peak output in excess of 1½ watts.
- All standard British components.
- Built on printed circuit panel size 6 × 3in.
- Generous size Driver and Output Transformers.
- Output transformer tapped for 3 ohm and 15 ohm speakers.
- Transistors (GET114 or S1 Mullard AC 128D and matched pair of AC128 o/p).
- 9 volt operation.
- Everything supplied, wire, battery clips, solder, etc.
- Comprehensive easy to follow instructions and circuit diagram **2/6** (Free with Kit). All parts sold separately.

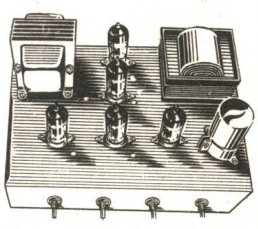
SPECIAL PRICE 45/-. P. & P. 3/-. Also ready built and tested, **52/6**. P. & P. 3/-.

HARVERSON'S SUPER MONO AMPLIFIER

A super quality gram amplifier using a double wound mains transformer, EZ80 rectifier and ECL82 triode pentode valve as audio amplifier and power output stage. Impedance 3 ohms. Output approx. 3·5 watts. Volume and tone controls. Chassis size only 7in. wide × 3in. deep × 6in. high overall. AC mains 200/240V. Supplied absolutely Brand New completely wired and tested with valves and good quality output transformer. FEW ONLY.

OUR ROCK BOTTOM BARGAIN PRICE 49/6 P. & P. 6/-

10/14 WATT HI-FI AMPLIFIER KIT



A stylishly finished monaural amplifier with an output of 14 watts from 2 EL84s in push-pull. Super reproduction of both music and speech, with negligible hum. Separate inputs for mike and gram allow records and announcements to follow each other. Fully shrouded section wound output transformer to match 3–15Ω speaker and 2 independent volume controls, and separate bass and treble controls are provided giving good lift and cut. Valve line-up 2 EL84s, ECC83, EF86 and EZ80 rectifier. Simple instruction booklet **2/6** (Free with parts). **All parts sold separately.** ONLY **£7.9.6.** P. & P. 8/6. Also available ready built and tested complete with std. input sockets, **£9.5.0.** P. & P. 8/6.

Open all day Saturday
Early closing Wed. 1 p.m.

A few minutes from South Wimbledon Tube Station

HARVERSON SURPLUS CO. LTD.

170 HIGH ST., MERTON, LONDON, S.W.19 Tel. 01-540 3985

SEND STAMPED ADDRESSED ENVELOPE WITH ALL ENQUIRIES

(Please write clearly)

PLEASE NOTE: P. & P. CHARGES QUOTED APPLY TO U.K. ONLY. P. & P. ON OVERSEAS ORDERS CHARGED EXTRA.

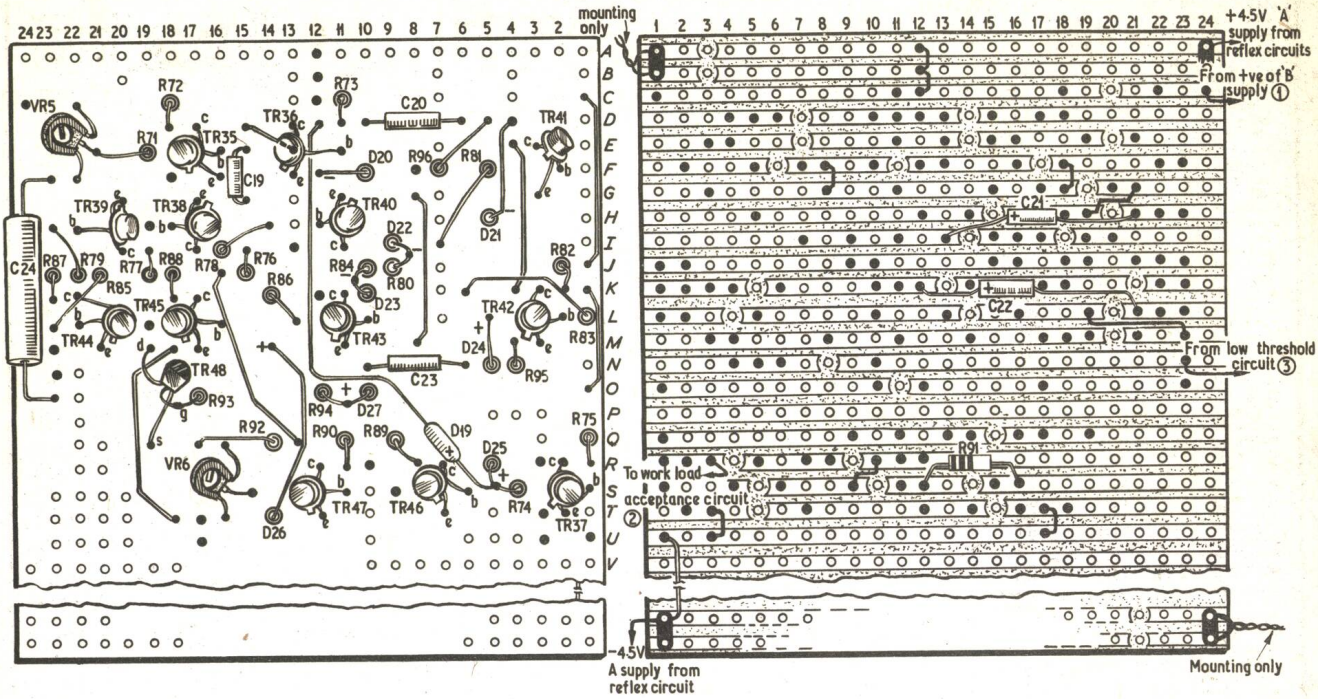

mounting only
+4.5V 'A' supply from reflex circuits
From +ve of 'B' supply ①
From low threshold circuit ③
To work load acceptance circuit ②
-4.5V A supply from reflex circuit
Mounting only

Fig. 6. Component layout and wiring for the new board: (a) component side, (b) copper side showing breaks in the copper strips

Transistor TR41 will also turn off, and the common collector point of TR41, TR42 will go positive for a time, essentially determined by the period of the differential monostable, i.e. one second or less if the extension monostable is close to the end of its quasi stable state. The output from the coincidence gate is taken to the summation circuit.

SUMMATION CIRCUIT AND "LEARNT" THRESHOLD

As implied by its designation, the summation circuit adds or integrates the output pulses from the coincidence gate and comprises TR48 and its associated components. Capacitor C24 and R94 provide a time-constant sufficiently long to ensure that the maximum summation limit extends to accepting greater than 15 input pulses.

Unwanted discharge of the capacitor is minimised by inclusion of D27 and by the very high input impedance presented by TR48 which is an f.e.t. Initially TR48 will be conducting, but as pulses from the coincidence gate gradually charge C24 so the voltage at TR48 source will climb towards the positive rail.

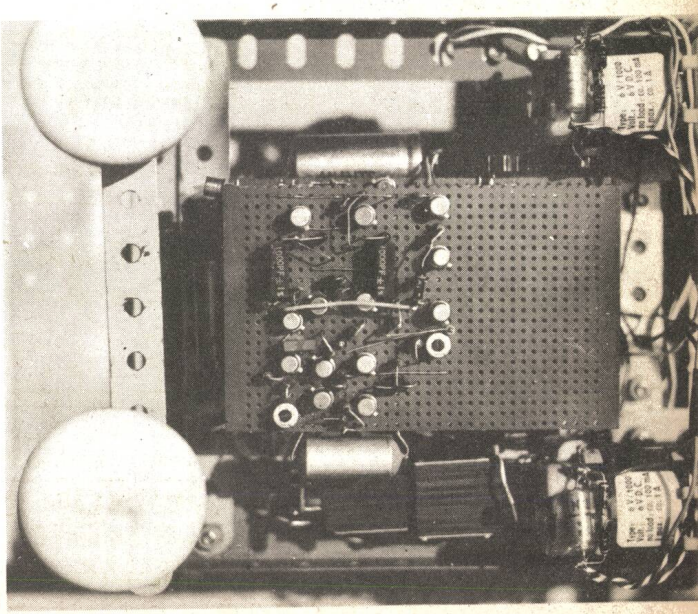
At some level of summation, dependent upon where VR6 has been set, the learnt threshold Schmitt will switch causing TR37 to turn on. This condition will remain until the level on C24 drops below the point necessary to maintain the Schmitt in the triggered state.

However, due to the reasons discussed earlier this will take a fair time and consequently TR37 will remain on to ensure that EMMA accepts higher loads at low supply levels. Of course, if this state of affairs is not reinforced periodically by giving EMMA a short rise in her "B" supply level then the voltage across C24 will gradually decay to a point where the load threshold drops again.

CIRCUIT BOARD CONSTRUCTION

The method for layout and wiring of the learning system circuit board is shown in Figs. 6a and 6b. Depending on the potentiometers used the Veroboard may require some drilling, however, all other components are mounted by way of their individual leads. The board itself is attached to the existing reflex board by 18 s.w.g. wire soldered to its four corners.

Underside view of EMMA showing the new circuit board



It is important to note that all necessary breaks in the copper strip should be made prior to mounting the various components.. Care should be taken to ensure that the complete width of the copper has been removed at each break.

Always mount transistors and diodes last and be sure not to keep them in contact with the soldering iron longer than necessary.

CHECKOUT

When the work on the circuit board has been completed it should be carefully examined to make sure that no dry joints or solder bridge-overs exist and that all components are carefully connected. It can now be inter-connected with the remainder of EMMA's anatomy.

Set EMMA's muscle control and the reflex system switches on. Connect a meter between the zero point of the supply batteries and the positive rail of the "B" supply to ensure that the level is approximately 4·5V. Operate the microswitch and check that this level falls to 3V. Release the microswitch and disconnect the meter. Inhibit EMMA's random generator circuit by turning the associated Schmitt permanently on through the use of VR1. Ensure that both motors are running.

SUPPLY LEVEL SCHMITT

Place EMMA on the ground and adjust VR2 so that she will carry a relatively heavy load, but goes into the avoidance reaction upon bumping into an obstacle.

Return EMMA to the work bench and with the meter connected between the collector of TR36 and the negative rail of the "A" supply, adjust VR5 until the supply level Schmitt *just* triggers, evidenced by the meter reading almost rail potential. Operate the microswitch and ensure that the meter reading drops to near zero level; if not, re-adjust the Schmitt. Disconnect the meter.

Now place EMMA back on the ground and replace the load. Ensure that, as before, the avoidance reaction does not occur unless she meets with an obstruction. Operate the microswitch and check that both EMMA's speed is reduced and that she immediately goes into the avoidance mode. If she is functioning correctly return EMMA once more to the table.

DIFFERENTIAL AND EXTENSION MONOSTABLE

Connect the meter between the common collector point of TR41, TR42 and the negative rail of the "A" supply; there should be an almost zero reading.

Now simulate a load by stalling the road wheels and, shortly following this, operate the microswitch. There should be a reading of almost rail potential. If not, check that the differential and extension monostables are functioning—the meter connected to either TR40 or TR43 collector will establish this following triggering.

Transfer the meter to the source of TR48. Momentarily short out C24 when the meter reading should be approximately 1V. Trigger the extension monostable, as before, and operate the microswitch every couple of seconds or so. Ensure that there is a gradual increase in the meter reading.

Note that it may be necessary to re-trigger the extension monostable because its time period could have elapsed during this check. Momentarily short out C24 again and check that the meter reading falls once more to about 1V.

LEARNT THRESHOLD SCHMITT

Connect the meter now to the collector of TR46 and set VR6 wiper about midway. The reading on the meter should be near zero. Operate the microswitch occasionally and apply a simulated load from time to time. Ultimately the meter will indicate that the learnt threshold Schmitt has triggered.

Naturally, it is a matter of choice as to the point in the summation curve where one wants this Schmitt to trigger, but a sensible arrangement would be to have the summer integrate about ten or eleven pulses before this occurs. It is simple to control this factor by varying the setting of VR6.

FINAL CHECK

If everything checks out remove the meter and short out C24 again to make sure EMMA forgets all about our unbridled inquisition of her internal parts. Set EMMA down on the floor once more and make this final check!

Place a fairly heavy book on EMMA's back and operate the microswitch periodically. After a time (that will probably seem like an eternity) EMMA will carry the load under reduced power supply conditions. The easiest way to maintain the low supply state for a while is to clip a clothes peg across the microswitch and so hold the operating button depressed.

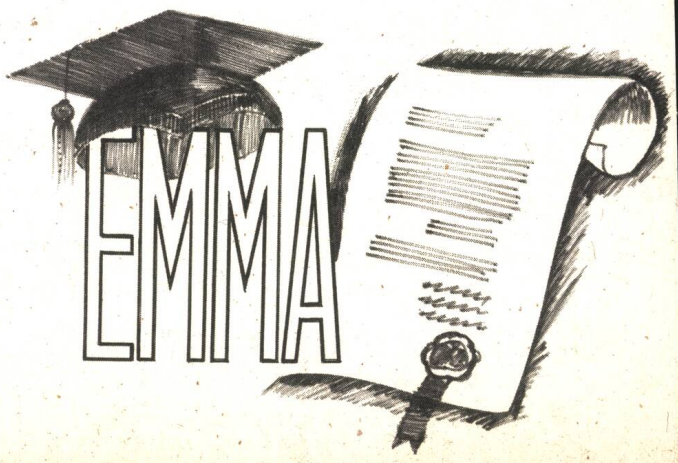
Remember that EMMA's batteries don't last forever, so do start off with fresh ones. A heavily loaded supply on its "last legs" may make it virtually impossible to set up the monitoring circuits for reliable operation.

FINAL EMMA

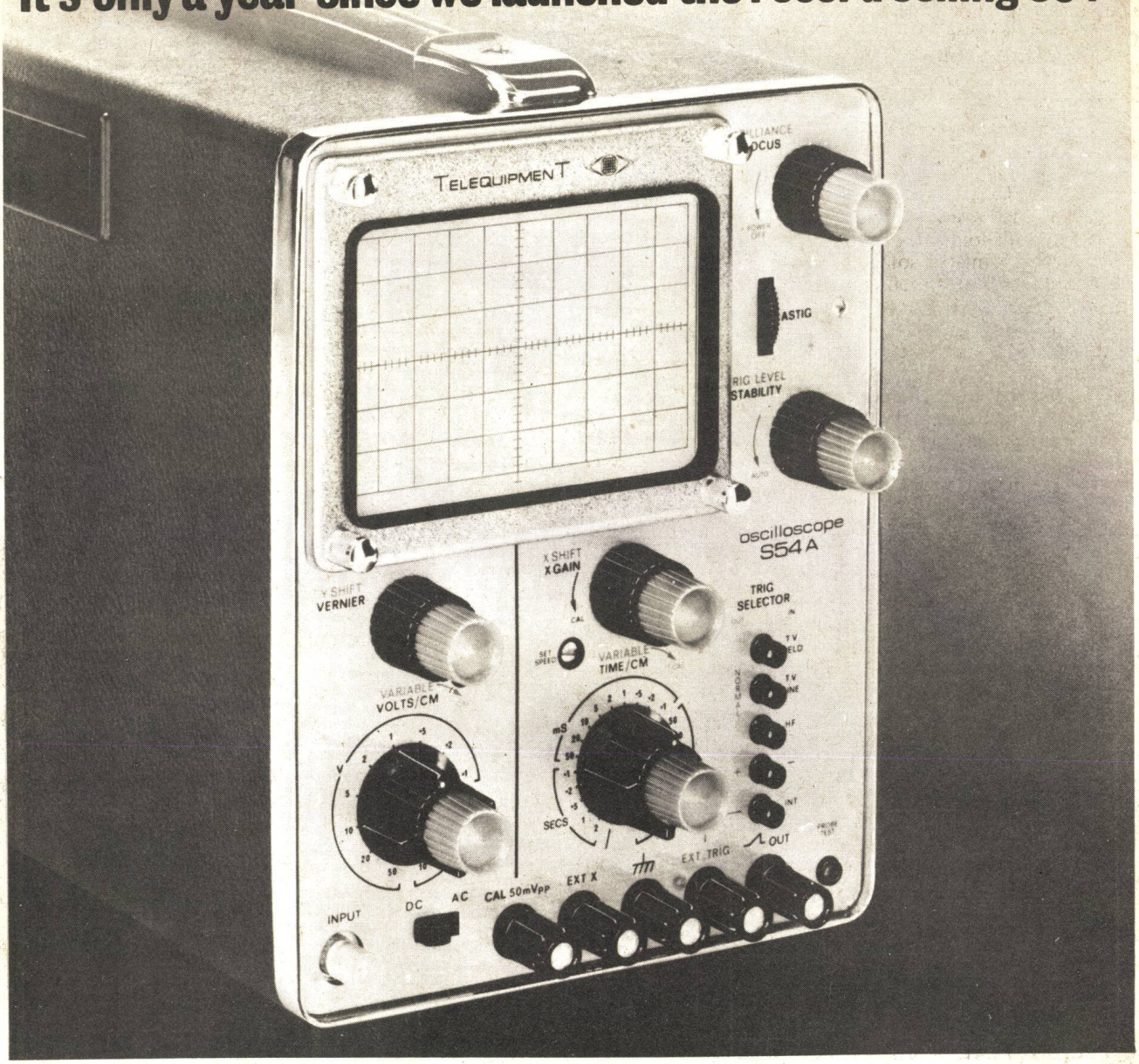
You may have every reason to say "All this just to have a heap of electronics and metalwork behave in this odd fashion." But that is the very point, it *is* just a heap of electronics and metalwork—not a living creature! Crude though she may be EMMA definitely shows certain preferences and can learn that some actions are worth the trouble while others are not.

To demonstrate that a machine can have a kind of self preservation awareness, we have cheated a little by playing around with the power supplies used. The reason though is valid because had we employed, say, re-chargeable nickel cadmium cells it would have been virtually impossible to see EMMA exhibit this new ability.

However, there is no reason why a keen Bionics man should not attempt an even more ambitious scheme—after all there is a machine in existence which can go and plug itself into the nearest 13 amp socket when it feels peckish! ★



It's only a year since we launched the record selling S54



Now we introduce the S54A...

. . . a single beam oscilloscope with a sensitivity of 10mV/cm at 10MHz bandwidth

The S54A is **an all solid state** oscilloscope developed from the S54. Smartly styled yet ruggedly built, the S54A has a wide application in field work, in the laboratory and in production line testing. Look at the features:

- ✳ 10MHz Bandwidth at 10mV/cm
- ✳ All Solid State Design
- ✳ Small Size — Light Weight
- ✳ FET Inputs
- ✳ Versatile Triggering including T.V. Line and Frame Sync.
- ✳ 6 x 10cm. Viewing Area
- ✳ Built-in Voltage Calibrator.

At £120 you will find no other oscilloscope of its type which offers such features at such low cost. Write or phone for full specification NOW! ! ! !

TELEQUIPMENT

Telequipment Limited, 313 Chase Road, Southgate, London, N.14. Telephone: 01-882 1166. Telex: 262004.
A member of the Tektronix Group. For Overseas enquiries write to: Tektronix Ltd., P.O. Box 48, Guernsey, C.I.

TRANSISTOR RADIOS TO BUILD YOURSELF

Backed by after sales service

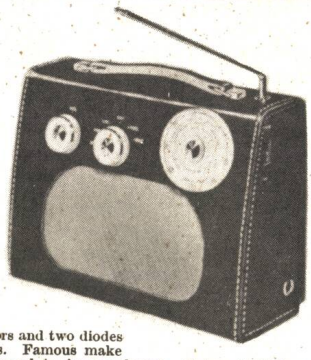
NEW! roamer eight mk 1

WITH VARIABLE TONE CONTROL

7 Tunable Wavebands: Medium Wave 1, Medium Wave 2, Long Wave, S.W.1, S.W.2, S.W.3, and Trawler Band. Built in ferrite rod aerial for Medium and Long Waves. 5 section 22in chrome plated telescopic aerial for Short Waves can be angled and rotated for maximum performance. Push-pull output using 600Mw type transistors. Socket for car aerial. Tape record socket. Selectivity switch. Switched earpiece socket complete with earpiece for private listening. 8 transistors plus 3 diodes. Famous make 7 × 4in speaker. Air spaced ganged tuning condenser. On/off switch volume control. Wave change switch and tuning control. Attractive case in rich chestnut shade with gold blocking. Size 9 × 7 × 4in approx. Easy to follow instructions and diagrams make the Roamer Eight a pleasure to build. Parts price list and easy build plans 5/- (FREE with parts).

Total building costs £6.19.6 P. & P. 7/6

roamer seven mk IV



7 FULLY TUNABLE WAVE BANDS—M.W.1, M.W.2, L.W., S.W.1, S.W.2, S.W.3 and Trawler Band. Extra Medium waveband provides easier tuning of Radio Luxembourg, etc. Built in ferrite rod aerial for Medium and Long Waves. 5 Section 22in chrome plated telescopic aerial for Short Waves—can be angled and rotated for peak S.W. listening. Socket for Car Aerial. Powerful push-pull output. 7 transistors and two diodes including Micro-Alloy R.F. Transistors. Famous make 7 × 4in P.M. speaker. Air spaced ganged tuning condenser. Volume/on/off control, wave change switches and tuning control. Attractive case with carrying handle. Size 9 × 7 × 4in approx. Easy to follow instructions and diagrams make the Roamer 7 a pleasure to build. Parts price list and easy build plans 3/- (FREE with parts).

Total building costs £5.19.6 P. & P. 7/6

Personal Earpiece with switched socket for private listening, 5/- extra.

NEW! transeight

SIX WAVEBAND PORTABLE WITH 3in. SPEAKER

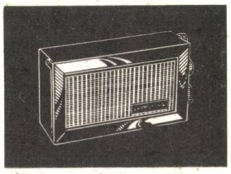
Attractive case in black with red grille and cream knobs and dial with polished brass inserts. Size 9 × 5½ × 2¾in. approx. Tunable on Medium and Long Waves, 3 Short Waves and Trawler Band. Sensitive ferrite rod aerial for M.W. and L.W. Telescopic aerial for Short Waves. 8 improved type transistors plus 3 diodes. Push-pull output. Ample power to drive a larger speaker. Parts price list and easy build plans 5/- (FREE with parts).

Total building costs 89/6 P. & P. 5/6

Earpiece with switched socket for private listening 5/- extra.

pocket five

MEDIUM WAVE, LONG WAVE AND TRAWLER BAND PORTABLE WITH SPEAKER AND EARPIECE



Attractive black and gold case. Size 5½ × 1½ × 5½in. Tunable over both Medium and Long Waves with extended M.W. band for easier tuning of Luxembourg, etc. 7 stages—5 transistors and 2 diodes, supersensitive ferrite rod aerial, fine tone moving coil speaker, also Personal Earpiece with switched socket for private listening. Easy build plans and parts price list 1/6 (FREE with parts).

Total building costs 44/6 P. & P. 3/6

transona five

MEDIUM WAVE, LONG WAVE AND TRAWLER BAND PORTABLE WITH SPEAKER AND EARPIECE

Attractive case with red speaker grille. Size 6½ × 4½in × 1½in. 7 stages—5 transistors and 2 diodes, ferrite rod aerial, tuning condenser, volume control, fine tone moving coil speaker also Personal Earpiece with switched socket for private listening. Easy build plans and parts price list 1/6 (FREE with parts).

Total building costs 47/6 P. & P. 3/9

roamer six

SIX WAVEBAND PORTABLE WITH 3in. SPEAKER

Attractive case with gilt fittings. Size 7½ × 5½ × 1¾in. Tunable on Medium and Long Waves, two Short Waves, Trawler Band plus an extra M.W. band for easier tuning of Luxembourg, etc. Sensitive ferrite rod aerial and telescopic aerial for Short Waves. 8 stages—6 transistors and 2 diodes including Micro-Alloy R.F. Transistors, etc. (Carrying strap 1/6 extra). Easy build plans and parts price list 2/- (FREE with parts).

Total building costs 79/6 P. & P. 4/6

* *Callers side entrance Stylo Shoe Shop*

* *Open 10-1, 2.30-4.30 Mon.-Fri. 9-12 Sat.*

RADIO EXCHANGE LTD

61a, HIGH STREET, BEDFORD. Tel. 0234 52367

I enclose £..... please send items marked

ROAMER EIGHT	☐	ROAMER SEVEN	☐
TRANSEIGHT	☐	POCKET FIVE	☐
TRANSONA FIVE	☐	ROAMER SIX	☐

Parts price list and plans for.....

Name.....

Address.....

.....

.....PE 1

MARKET PLACE

Items mentioned in this feature are usually available from electronic equipment and component retailers advertising in this magazine. However, where a full address is given, enquiries and orders should then be made direct to the firm concerned.

TURNTABLE KIT

Something new for the audio fan is the Connoisseur BD1 belt drive turntable kit from **A. R. Sugden & Co. (Engineering) Ltd.,** Market Street, Brighouse, Yorkshire.

It is claimed the kit can be assembled by the constructor within the hour and the only tools required are a small screwdriver, a pair of pliers and a spanner. No soldering is necessary.

The turntable operates at 33⅓ and 45 r.p.m. and the use of a belt drive system is claimed to reduce vibration and transmission noise to a minimum. The turntable is of non-ferrous aluminium casting and speed change

Multi-Mini Twin from Coventry Movement

is carried out manually by shifting the belt on the pulley, eliminating mechanical linkages.

The turntable works from the mains, 200/240V a.c., and the rumble is claimed at −60dB when referred to a velocity of 70cm/sec at 1kHz. Hum level is −80dB and wow and flutter is less than 0·1 per cent. The motor used is a slow speed synchronous type running at 375 r.p.m. at 50Hz.

The price of the BD1 kit is £9 9s plus tax. A plinth, dust cover lid and a SAU2 pick-up arm is available as extras.

UNIVERSAL VICE

Recently we mentioned a workshop base and workholder; now we have received brief details of a universal two-in-one vice and base.

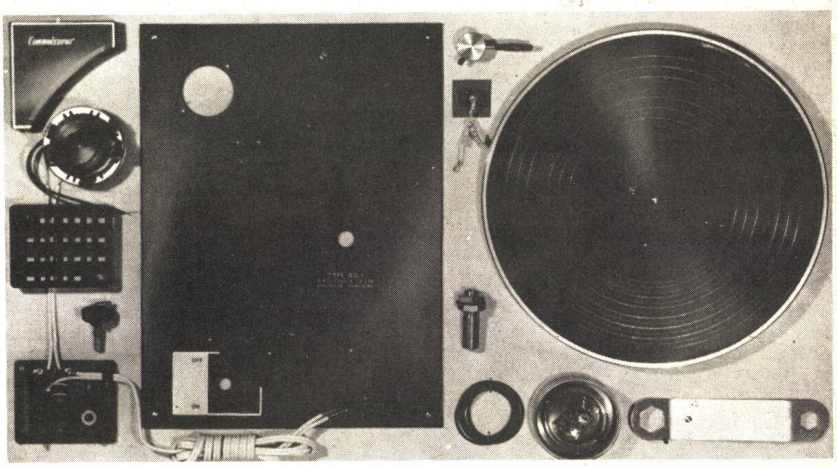
Called the Multi-Mini Twin, it features two sets of adjustable jaws, which can be set to any angle up to 360 degrees. The advantage of this arrangement is that any two separate components can be held in any desired position. It should be invaluable for the home workshop as a drilling jig, clamp for gluing or soldering, or as a table-top camera tripod.

Full details of the Multi-Mini Twin (price £5 18s) and a standard Multi-Mini can be obtained from **The Coventry Movement Co., Ltd.,** Burnsall Road, Coventry.

tors, transistors, lamp, and light dependent resistor are mounted on a plastics base with threaded brass fixing pillars. Also included is an earphone, ferrite cored coil, nuts, bolts, washers and box spanner.

All experiments when completed are working models and projects include a transistor radio, burglar alarm, morse code practice oscillator, etc.

The Radionic X30 retails for £7 19s 6d, including tax, and is available from electrical shops and some toy departments of large stores.



Connoisseur BD1 turntable kit marketed by A. R. Sugden & Co.

CONSTRUCTION KIT

A series of 30 experiments aimed at gradually increasing the beginner's understanding of radio and electronic circuits is contained in the Radionic X30 constructional kit from **Radionic Products.**

The kit consists of a special printed circuit board and a complete instructional manual for all projects; plus a section on fundamentals of electricity and electronics. The resistors, capaci-

PRINTED CIRCUITS

Many readers may be interested to learn that **P.H. Electronics** are now producing printed circuit boards of some of the past constructional articles published in PRACTICAL ELECTRONICS.

The board is drilled and roller tinned and an instruction sheet is also included. The instruction sheet contains only minimum information and purchasers of boards are referred to the relevant issue of the magazine.

Further details of the boards available and prices can be obtained from P.H. Electronics, Sandwich Industrial Estate, Sandwich, Kent.

Radionic Products X30 construction kit

Readout—
A SELECTION FROM OUR POSTBAG

Correspondents wishing to have a reply must enclose a stamped addressed envelope. We regret we are unable to guarantee a reply on matters not relating to articles published in the magazine. Technical queries cannot be dealt with on the telephone.

Component supermarket

Sir—As many readers will have noticed, the Mecca of London based enthusiasts, Tottenham Court Road, has recently become the home of showrooms for expensive ready-made gear, several cinemas showing "adult" films and an avant-garde theatre. While not wishing to decry these innovations, the inevitable long term result of Tottenham Court Road becoming a part of "swinging" London will be a rise in property values, which will drive away and disperse the component shops.

This is a threat, but also a challenge. After all, is there any real reason why an electronics supermarket, with stands from all the main suppliers, couldn't be established? Maybe under the trilateral leadership of the electronics magazines, the learned societies and commercial interests.

It may sound like an impossible dream now, but if such a venture could be established, not only would it prove highly lucrative but, by encouraging our vital hobby, the electronics industry and also the whole nation would gain through an increased awareness of electronics.

S. H. Hertz,
London, N.3.

We suspect there will be some disagreement concerning the actual location of the component seekers' "mecca". Some enthusiasts might plump for Lisle street!—Ed.

Liquid etchant

Sir—Several younger constructors have asked me from time to time what the liquid is that is used to etch printed circuits; often they have bought a printed circuit kit, and the etchant is used up first.

A recent article described an excellent solution made up of several fluids, one of which was dilute hydrochloric acid. This solution was in fact the classical circuit etchant, but I now find that in some areas chemists will not sell dilute acid to younger persons, or do not stock it in any case.

I feel, therefore, that it may be of value to tell them through your columns that there is a very good etchant available through any chemist, under the pharmacist's name of Liquor Ferri Perchloridi. The British Drug House sells this in convenient 500ml bottles, for a few shillings.

There are two points to watch, however; the first is that it makes an excellent dye for clothing. The second is that, diluted with water, it is sometimes used as an "iron tonic", and the buyer must therefore be careful to obtain the concentrated variety (ask for "fort"), and to keep it well away from any medicine cupboards.

The compound formed with copper is a heavy black precipitate, and it is therefore necessary to agitate the circuit panel in the solution for up to 10 minutes to ensure even etching.

J. Anderson,
Macclesfield,
Cheshire.

There is another point that should be remembered: this solution contains an appreciable amount of acid and so should be handled with care. In particular, it must NOT be poured down the sink, especially if the plumbing is copper.—Ed.

Too ambitious?

Sir—Since the August issue of PRACTICAL ELECTRONICS was published I have felt that your magazine has been catering for the more ambitious of your readers, and is paying little attention to the man with a limited amount of time and money. This has been verified by the list of constructional projects in the November 1969 issue. All these projects (except perhaps the *I.C. Basic Amplifier*) are costly and time consuming.

Bring back ones like the *Homecom*, the *Electronic Stockmarket* or the beginner's projects!

E. W. Lawson,
Glasgow.

We have a very wide readership, and interests vary considerably. Certainly you can expect to see more basic projects in the future, and articles specially designed for the beginner will be featured from time to time.—Ed.

Nematic crystals

Sir—I was pleased to find an article on *Conductive Glass* by F. J. Stone in your November issue. It must be very many years since I came across a really constructive project such as this (do-it-yourself is so cut and dried these days), and it is quite a thrill to get back to something requiring dexterity and luck for a sense of achievement.

The Variable Transparency window is particularly interesting, and I should like to construct one as a project with a group of the Merton Science Society. Unfortunately, Mr Stone does not tell us how to make a *nematic liquid* or how high a potential must be applied across a $\frac{1}{4}$in thickness of liquid. Perhaps you could get him to pass on this vital information.

By the way, according to the precautions which he quite rightly warns us about, he says that tin is poisonous, but surely tin is harmless otherwise how is it that all our food is kept in tin cans?

George E. Dunning,
Morden,
Surrey.

The only nematic liquid crystal known to me is one referred to in the October 31, 1968 edition of the *New Scientist*, page 260, "Trends and Discoveries", "Lining up Dye Molecules to Switch Light Colours", which effect I referred to in my article. This uses methyl red dye in a 0·1 to 1·0 per cent (by weight) solution in the host liquid crystal, P-N Butoxy Benzoic Acid, with the glass plates about 12 micrometres apart.

The above named liquid is, as I expect most others are, not so readily available. It is one thing to know the name of a substance, but it is another thing altogether to obtain it. There are more liquids in this general group which exhibit this or similar effects. I am sorry I cannot provide any further information regarding the availability of nematic liquid crystals.—F.J.S.

Glass centre

Sir—I was most interested to read F. J. Stone's article on *Conductive Glass* in November 1969 PRACTICAL ELECTRONICS, but do not feel I can cope with the experiment of making my own.

Do you think if I advertised in your miscellaneous column a supplier could be found?

When I enquired at the "glass centre" at the Building Exhibition, no-one appeared to have a clue. According to Stone's article, the Russians appear to have it, so where are we in this research?

Perhaps I have not done enough reading outside electronics and Pilkington and Triplex have the answer.

Leslie D. E. Light, G3KDL,
Wembley,
Middlesex.

2½kW FAN HEATER

Three position switching to suit changes in the weather. Switch up for full heater (2½ kW), switch down for half heat (1¼kW), switch central blows cold for summer cooling —adjustable thermostat acts as auto control and safety cut-out. Complete kit **£3.15.0.** Post and ins. 7/6 or made up model **£4.15.0.** Post & ins. 7/6.

FLUORESCENT CONTROL KITS

Each kit comprises seven items—Choke, 2 tube ends, starter, starter holder and 2 tube clips, with wiring instructions. Suitable for normal fluorescent tubes or the new "Grolux" tubes for fish tanks and indoor plants. Chokes are super-silent, mostly resin filled. Kit A—15–20w. **19/6.** Kit B—30–40w. **19/6.** Kit C– 80w. **19/6.** Kit E —65w. **19/6.** Kit MF1 is for 6in., 9in. and 12in. miniature tubes, **19/6.** Postage on Kits A and B 4/6 for one or two kits then 4/6 for each two kits ordered. Kits C, D and E 4/6 on first kit then 3/6 for each kit ordered. Kit MF1 3/6 on first kit then 3/6 on each two kits ordered.

BECKASTAT

This is an instant thermostat, simply plug your appliance into it and its lead into wall plug. Adjustable setting for normal air temperatures. 13A loading. Will save its cost in a season. **19/6.** Post and insurance 2/9.

REED SWITCHES

Glass encased, switches operated by external magnet—gold welted contacts. We can now offer 3 types.

Miniature. 1in. long × approximately ¼in. diameter. Will make and break up to ½ amp up to 300 volts. Price **2/6** each. **24/-** dozen.

Standard 2in. long × 3/16in. diameter. This will break currents of up to 1 amp, voltages up to 250 volts. Price **2/-** each. **18/-** per dozen.

Flat. Flat type, 2in. long, just over 1/16in. thick, approximately ¼in. wide. The Standard Type flattened out, so that it can be fitted into a smaller space or a larger quantity may be packed into a square solenoid. Rating 1 amp, 200 volts. Price **6/-** each. **£3** per dozen.

Small ceramic magnets to operate these reed switches **1/3** each. **12/-** dozen.

15 Amp FOOT SWITCH

Suitable for Sewing Machine Motor, Drilling Machine or in fact to switch any job where both hands are to be left free. Rated at 13 amps, 250 volts. Price **22/6.**

3 DIGIT COUNTER

For Tape Recorder or other application, re-settable by depressing button. Price **8/6.**

TRANSDUCER

Made by Acos, reference No. 1.D.1001. For measuring vibration, etc., to be used in conjunction with "G" Meter. Regular price £5. Our price **49/6.** Brand new and unused.

ISOLATION SWITCH

20 Amp D.P. 250 volts. Ideal to control Water Heater or any other appliance. Neon indicator shows when current is on, **4/6.** **48/-** per dozen.

LIGHT CELL

Almost zero resistant in sunlight increases to 10 K. Ohms in dark or dull light, epoxy resin sealed. Size approx. 1in. dia. by ¼in. thick. Rated at 500MW, wire ended. **8/6** with circuit.

FLEX BARGAINS

Screened 3 Core Flex. Each core 14/0076 Copper PVC insulated and coloured, the 3 cores laid together and metal braided overall. Price **£3.15.** per 100 yds. coil.

15 Amp 3 Core Non-kink Flex. 70/0076 insulated coloured cores, protected by tough rubber sheath, then black cotton braided with white tracer. A normal domestic flex as fitted to 3 kw. fires. Regular price 3/6 per yd. 50 yd. coil **£4.10.0,** or cut to your length 2/6 per yard.

10 Amp 3 Core Non-kink Flex. As above but cores are 28/0076 Copper. Normal price 2/6 per yd. 100 yd. coil **£7.10.0,** or cut to your length **1/9** yd.

6 Amp 2 Core Flex. As above, but 2 Cores each 23/0076 as used for Vacuum Cleaners, Electric Blankets, etc. **39/6** 100 yd. coil.

23/0076 Triple Core P.V.C. covered, circular, normally sold at 1/6 yd. Our price 100 yd. coil **£3.19.6.** Post and Insurance 6/6.

12 VOLT SOLENOID

For energizing Reed Switches, etc., size approx. ¾in. long by 1in. diameter. Hole through Solenoid approx. ⅜in. **8/6** each.

'GLADIATOR' 2 WAVE BAND TRANSISTOR RADIO

7 transistor, 2 wave band (medium and long) pocket radio with carrying handle and earplug. These radios use a ferrite slab aerial and a conventional superhet circuit with built in moving coil speaker. Completely built up, ready to play. Offered at less than importers price due to bankrupt purchase. A remarkable bargain. **39/6** plus 3/6 post and insurance.

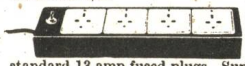
MINIATURE EXTRACTOR FAN

Beautifully made by famous German Company. PAPST System, 230/240 A.C. Mains operated, size 3¼in. × 3¼in. × 2in. Made for instrument cooling but ideal to incorporate in a cooker hood, etc. **65/-.**

BUY TIME SLOT METERS

If you hire out equipment such as TV sets by the hour then these slot meters are what you require. We have 3 types, 8d. an hour, 1/- an hour and 1/6 an hour. Brand new. Made by the famous Weston Company. Price **£3.19.6,** postage and insurance 6/6.

DISTRIBUTION PANELS



Just what you need for work bench or lab. 4 × 13 amp sockets in metal box to take standard 13 amp fused plugs. Supplied complete with 6 feet of heavy cable and 13 amp plug. Similar advertised at £5. Our price **39/6** in kit form + 4/6 P. & I. or **45/-** + 4/6 P. & I. wired up.

THIS MONTH'S SNIP

24 HOUR TIME SWITCH

Mains operated. Adjustable Contacts give on/off per 24 hours. Contacts rated 20 amps, repeating mechanism so ideal for shop window control, or to switch hall lights (anti-burglar precaution) while you are on holiday. Made by the famous Smiths Company. This month only **39/6** plus 3/6 postage and insurance, a real snip which should not be missed.

DOUBLE ENDED MAINS MOTOR

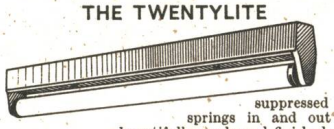
On feet with holes for screw-down fixing. To drive models, oven, blower heater, etc. **10/-** each, plus 3/6 post and insurance. 6 or more post free.

INSTRUMENT MOTOR WITH GEAR BOX

Made by the famous Smiths Company. This motor operates from 20-26 volts 50 c.p.s. or from higher voltages through transformers or resistors: It has an 8-gear train in perspex gear box final shaft speed is 1 rev. per hour. Approximate dimensions, motor 1¼in. × 1¼in. diameter, gear box ⅔in. × 2¼in. diameter. Although only 2 watt motor this is really powerful and impossible to stop by hand. **35/-.** Mains operated and available with final speeds 1 R.P.M., 4 R.P.M., 30 R.P.M., 60 R.P.M., 1 rev. per hour **35/-.**

ATLAS SLIMLINE FLUORESCENTS

THE TWENTYLITE



A Fluorescent lighting unit made by the famous Atlas company, with super silent polyester filled choke and radio suppressed starter. The tube springs in and out and the whole unit is beautifully made and finished white enamel. Amazingly economical. If left on all the time costs only one penny per day (uses ½ unit). Measures 2ft. long. Is ideal in Kitchen, Bedroom, Hallway, Porch, Loft, etc. Don't miss this amazing offer, **39/6** with tube. Assembled ready to install. 4ft. twin model **59/6.** Postage and insurance 6/6 extra.

1 WATT AMPLIFIER & PREAMP

5 transistors—highly efficient, made for use with tapehead G4 but equally suitable for microphone or pick up—limited quantity **29/6.** Full circuit diag. also shows tape controls **5/-.**

VARYLITE

Will dim incandescent lighting up to 600 watts from full brilliance to out. Fitted on M.K. flush plate, same size and fixing as standard wall switch so may be fitted in place of this, or mount on surface. Price complete in heavy plastic box with control knob **£3.19.6.**

HI-FI BARGAIN

FULL F1 12 INCH LOUDSPEAKER. This is undoubtedly one of the finest loudspeakers that we have ever offered, produced by one of the country's most famous makers. It has a die-cast metal frame and is strongly recommended for HI-Fi load and Rhythm Guitar and public address.

Flux Density 11,000 gauss—Total Flux 44,000 Maxwells—Power Handling 15 watts R.M.S. Cone Moulded fibre—Freq. response 30-10,000 c.p.s.—specify 3 for 15 ohms—Mains resonance 60 c.p.s.—Chassis Diam. 12in. 12¾in. over mounting lugs—Baffle hole 11in. Diam.—Mounting holes 4, holes —¼in. diam. on pitch circle 11¼in. diam. Overall height 5¼in. A £6 speaker offered for only **£3.9.6** plus 7/6 p. & p. Don't miss this offer. 15in. 30 watt **£7.19.6.** 18in. 100 watt **£24.10.0**

5 kW PORTABLE HEATER

For workshop—stores—greenhouse, etc. Uses twin balanced motors for silent operation and reliability, three position switch gives "max. heat," "half heat", and "blow cold". A really fine heater. Price **£9.19.6,** plus 10/6 post and insurance.

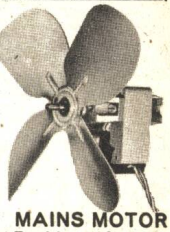
MINIATURE WAFER SWITCHES

2 pole, 2 way—4 pole, 2 way—3 pole, 3 way—4 pole, 3 way—2 pole, 4 way—3 pole, 4 way—2 pole 6 way—1 pole, 12 way. All at **3/6** each. **36/-** dozen, your assortment

WATERPROOF HEATING ELEMENT

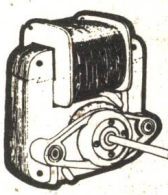
26 yards length 70W. Self-regulating temperature control. **10/-** post free.

AC FAN



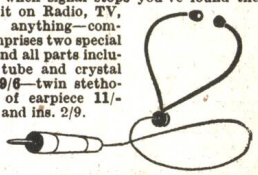
Small but very powerful mains motor with 5¾in. blades. Ideal for cooling equipment or as extractor. Silent but very efficient. **17/6,** post 4/6. Mounts from back or front with 4BA screws.

MAINS MOTOR



Precision made — as used in record decks and tape recorders—ideal also for extractor fan, blower, heaters etc. New and perfect. Snip at **9/6.** Postage 3/- for first one then 1/- for each one ordered. 12 and over post free.

RADIO STETHOSCOPE

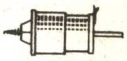


Easiest way to fault find—traces signal from aerial to speaker—when signal stops you've found the fault. Use it on Radio, TV, amplifier, anything—complete kit comprises two special transistors and all parts including probe tube and crystal earpiece. **29/6**—twin stethoset instead of earpiece **11/-** extra—post and ins. 2/9.

MAINS TRANSISTOR POWER PACK

Designed to operate transistor sets and amplifiers. Adjustable output 6v., 9v., 12 volts for up to 500mA (Class B working). Takes the place of any of the following batteries: PP1, PP3, PP4, PP6, PP7, PP9, and others. Kit comprises: mains transformer rectifier, smoothing and load resistor, condensers and instructions. Real snip at only **16/6,** plus 3/6 postage.

PHILIPS TRIMMER



0–30pF an old design but one which has never been bettered. **1/-** each, **10/-** doz., **£4.0.0** per 100.

MOTOR WITH GEARBOX

Very powerful 7 r.p.m., operates from standard A.C. mains. **29/6,** plus 3/6 P. & P.

INSTRUMENT BUZZER

6–12V, adjustable tone, a very neat metal cased U.S.A. made unit, approx. 1¼in. × 1in. × ¾in. **6/6** each.

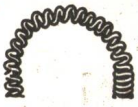
230 VOLT SOLENOID

¾in. stroke. Size 2¾in. × 2in. × 1¾in. **14/6,** postage 2/9.

PP3 BATTERY ELIMINATOR

Run your small transistor radio from the mains—full wave circuit—made up ready to wire into your set and adjustable high or low current. **8/6** each.

SPRING COIL LEADS



as fitted to telephones, 4 core **2/6** each, 3 core **2/-** each.

PANEL LAMPS

In neat plastic cases, available in several voltages as follows: 4v., 6v., 12v., 24v., 36v., 48v., 60v., 110v., 220v., 380v. Note all below 110v. are fitted with lamps. 110v. and above are neons. Price **3/-** each. **30/-** dozen.

APPLIANCE THERMOSTAT

This is a skeleton Type control intended for building into oven, for baking, curing, pottery, etc. 2 models, one preset for screwdriver control. The other has a shaft for knob control. Approximate operating temperature. Note only high temperature insulation used in these stats. Price **12/6** each.

Where postage is not stated then orders over £3 are post free. Below £3 add 2/9. Semiconductors add 1/- post. Over £1 post free. S.A.E. with enquiries please.

ELECTRONICS (CROYDON) LTD

Dept. PE, 266 London Road, Croydon CRO 2TH

Also 102/3 Tamworth Road, Croydon

CAR LIGHT FLASHERS

Heavy duty light flasher employs a condenser discharge principle operating on electro mechanical relay. (As inset.) Housed in strong plastic case. Flashing rate between 60-120 per minute. 12 volt DC operation. Maximum load 6 amps. Size 2 11/16" dia. × 4". Supplied brand new at a fraction of original cost. **6/6** each. P. & P. 2/6. (3 for **17/6**. P. & P. 4/6.)

R209 MK II COMMUNICATION RECEIVER

11 valve high grade communication receiver suitable for tropical use. 1·20 Mc/s on 4 bands. AM/CW/FM operation. Incorporates precision vernier driver, BFO. Aerial trimmer, internal speaker and 12 V d.c. internal power supply. Supplied in excellent condition, fully tested and checked.

£15

Carr. 20/-.

TYPE 13A DOUBLE BEAM OSCILLOSCOPES

An excellent general purpose D/B oscilloscope. T.B. 2 c/s–750 kc/s. Bandwidth 5·5 Mc/s. Sensitivity 33 mV/CM. Operating voltage 0/110/200/250 V. a.c. Supplied in excellent working condition. **£22.10.0** or complete with all accessories, probe, leads, lid, etc. **£25.** Carriage 30/-.

MARCONI CT44/-TF956 AF ABSORPTION WATTMETER

1 μ/watt to 6 watts. **£20.** Carr. 20/-.

SOLARTRON CD. 1016 OSCILLOSCOPE

Double beam. d.c. To 5 Mc/s. Excellent condition. **£55** each. Carr. 20/-.

CLASS D WAVEMETERS

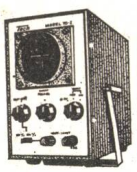
A crystal controlled heterodyne frequency meter covering 1·7–8 Mc/s. Operation on 6V d.c. Ideal for amateur use. Available in good used condition. **£5.19.6.** Carr. 7/6, or brand new with accessories. **£7.19.6.** Carr. 7/6.

CLASS D WAVEMETERS No. 2

Crystal controlled. 1·2–19 Mc/s. Mains or 12V d.c. operation. Complete with calibration charts. Excellent condition. **£12.10.0.** Carr. 30/-.

TO-2 PORTABLE OSCILLOSCOPE

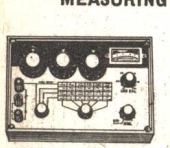
A general purpose low cost economy oscilloscope for everyday use. Y amp. Bandwidth 2 CPS–1 MHZ. Input imp. 2 megΩ 25 P.F. Illuminated scale. 2in. tube. 115 × 180 × 230mm. Weight 8lb. 220/240 V a.c. Supplied brand new with handbook. **£22.10.0.** Carr. 10/-.



SOLARTRON CD. 711S.2 OSCILLOSCOPES

Double beam. D.C. to 9 Mc/s. Perfect order. **£65.** Carr. 50/-.

TRANSISTORISED L.C.R. A.C. MEASURING BRIDGE

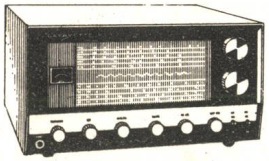


A new portable bridge offering excellent range and accuracy at low cost. Ranges: R. 1Ω–11·1 megΩ 6 Ranges ±1%. L 1 μH – 1 1 1 HENRYS 6 Ranges –2%. C. 10pF –1 1 1 0 m F d. 6 Ranges ±2%, TURNS RATIO 1:1/1000–1:11100. 6 Ranges ±1%. Bridge voltage at 1,000 cps. Operated from 9 volts. 100μA. Meter indication. Attractive 2 tone metal case. Size 7½ × 5 × 2in. **£20.** P. & P. 5/-.

UNR-30 4-BAND COMMUNICATION RECEIVER

Covering 550 Kc/s–30 Mc/s. Incorporates BFO. Built-in speaker and phone jack. Metal cabinet. Operation 220/240V. a.c. Supplied brand new, guaranteed with instructions. Carr. 7/6 **13 gns.**

TRIO JR-310 NEW AMATEUR BAND 10-80 METRE RECEIVER. In stock. **£77.10.0.**



LAFAYETTE SOLID STATE HA600 RECEIVER

5 BAND AM/CW/SSB AMATEUR AND SHORT WAVE 150 kc/s–400 kc/s and 550 kc/s–30 Mc/s F E T front end ● 2 mechanical filters ● Huge dial ● Product detector ● Variable BFO ● Noise limiter ● S meter ● 24in Bandspread ● 230V a.c./12V d.c. neg. earth operation ● RF gain control. Size 15in × 9¼in × 8½in. Weight 18lb. EXCEPTIONAL VALUE. £45. Carr. 10/-. S.A.E. for full details.

TRIO COMMUNICATION RECEIVER MODEL 9R-59DE

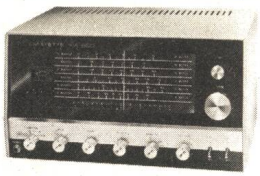
4 band receiver covering 550Kc/s to 30Mc/s. continuous and electrical bandspread on 10, 15, 20, 40 and 80 metres. 8 valve plus 7 diode circuit. 4/8 ohm output and phone jack. SSB-CW ● ANL ● Variable BFO ● S meter ● Sep. bandspread dial ● IF 445Kc/s ● Audio output 1·5W. ● Variable RF and AF gain controls. 115/250V A.C. Mains. Beautifully designed. Size: 7 × 15 × 10in. With instruction manual and service data. **£42** Carriage paid.
TRIO COMMUNICATION TYPE HEADPHONES Normally **£5.19.6.**
OUR PRICE **£3.15.0** if purchased with above receiver.

TRIO JR-500SE 10-80 Metre AMATEUR RECEIVER £69.10.0

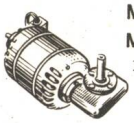
TRIO TS 510 AMATEUR TRANSCEIVER with speaker and mains P.S.U. £212

LAFAYETTE HA.800 SOLID STATE AMATEUR COMMUNICATION RECEIVER SIX BANDS 3.5-4, 7-7.3, 14-14.35, 21-45, 28-29.7, 50-54 Mc/s.

Dual conversion on all bands. 2 × 445 Kc/s mechanical filters. Product detector. Variable B.F.O. 100 Kc/s crystal calibrator. 'S' meter. Huge slide rule dial. Operation 230v AC or 12v DC. Size 15" × 9¾" × 8¼". Complete with instruction manual. **£57.10.0.** Carr. paid.
(100 Kc/s Crystal 39/6 extra)



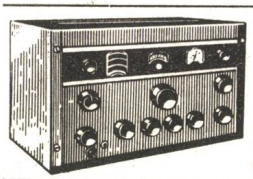
GEARED MAINS MOTORS



Paralux type 8D19 230/250V a.c. Reversible. 30 RPM. 40 lb in. Complete with capacitor. Excellent condition. **99/6.** Carr. 10/-.

CRYSTAL CALIBRATORS No. 10

Small portable crystal controlled wavemeter. Size 7" × 7½" × 4". Frequency range 500 Kc/s. 10 Mc/s (up to 30 Mc/s on harmonics). Calibrated dial. Power requirements 300 V.D.C. 15mA and 12 V.D.C. 0.3A. Excellent condition. **89/6.** Carr. 7/6.



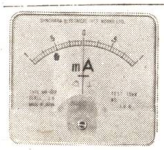
RCA COMMUNICATION RECEIVER AR88D

Latest release by ministry BRAND NEW in original cases. 110–250V a.c. operation. Frequency in 6 Bands. 535Kc/s–32Mc/s continuous. Output impedance 2·5–600 ohms. Incorporating crystal filter, noise limiter, variable BFO, variable selectivity, etc. Price **£87.10.0.** Carr. £2.

LAFAYETTE PF-60 SOLID STATE VHF FM RECEIVER

A completely new transistorised receiver covering 152–174 Mc/s. Fully tuneable or crystal controlled (not supplied) for fixed frequency operation. Incorporates 4 INTEGRATED CIRCUITS. Built in speaker and illuminated dial. Squelch and volume controls. Tape recorder output. 75Ω aerial input. Headphone jack. Operation 230V. A.C./12V. D.C. Neg. earth. **£37.10.0.** Carr. 10/-.

CLEAR PLASTIC PANEL METERS



First grade quality Moving Coil panel meters.
Type MR 38P. $1^{21}/_{32}$in square fronts.

50μA	40/-	500-0-500μA	27/6	50mA	27/6
50-0-50μA	37/6	1mA	27/6	100mA	27/6
100μA	37/6	1-0-1mA	27/6	150mA	27/6
100-0-100μA	35/-	2mA	27/6	200mA	27/6
200μA	35/-	5mA	27/6	300mA	27/6
500μA	40/-	10mA	27/6	500mA	27/6
		750mA	27/6	3V. D.C.	27/6
		1 amp	27/6	10V. D.C.	27/6
		2 amp	27/6	20V. D.C.	27/6
		5 amp	27/6	100V. D.C.	27/6
		20mA	27/6		

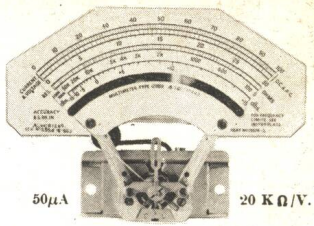
150V. D.C.	27/6	
300V. D.C.	27/6	
500V. D.C.	27/6	
750V. D.C.	27/6	
15V. A.C.	27/6	
50V. A.C.	27/6	
150V. A.C.	27/6	
300V. A.C.	27/6	
500V. A.C.	27/6	
8 meter 1mA.	32/-	
VU meter	42/-	

Full range of other sizes in stock. Send s.a.e. for leaflet.

POWER RHEOSTATS

High quality ceramic construction. Windings embedded in vitreous enamel. Heavy duty brush wiper. Continuous rating. Wide range ex-stock Single hole fixing, ¼in. dia. shafts. Bulk quantities available.
25 WATT. 10/25/50/100/250/500/1,000/1,500/2,500 or 5,000 ohms, **14/6.** P. & P. 1/6.
50 WATT. 10/25/50/100/250/500/1,000/2,500 or 5,000 ohms, **21/-.** P. & P. 1/6.
100 WATT. 1/5/10/25/50/100/250/500/1,000 or 2,500 ohms, **27/6.** P & P. 1/6.

AVOMETER MOVEMENTS



50μA 20 KΩ/V.

Spare movements for Model 8 or 9. (Fitted with Model 9 scale) or basis for any multimeter. Brand New and Boxed **69/6** P. & P. 3/6.

AVO 48A. Perfect order with set of shunts and resistances. **£12.10.0.** P. & P. 7/6.

T.E.40 HIGH SENSITIVITY A.C. VOLTMETER

10 meg. input 10 ranges: ·01 / ·03 / ·1 / ·3 / 1 / 3 / 10 / 30 / 100 / 300V. R.M.S. 4c/s.-1·2Mc/s. Decibels −40 to +50dB. Supplied brand new complete with leads and instructions. Operation 230V a.c. **£17.10.0.** Carr. 5/-.

LELAND MODEL 27 BEAT FREQUENCY OSCILLATORS

Frequency 0·20 Kc/s on 2 ranges. Output 500Ω or 5kΩ. Operation 200/250V. A.C. Supplied in perfect order. **£12.10.0.** Carr. 10/-.

TE-65 VALVE VOLTMETER

High quality instrument with 28 ranges. D.c. volts 1·5–1,500V. A.c. volts 1·5–1,500V. Resistance up to 1,000 megohms. 220/240V a.c. operation. Complete with probe and instructions. **£17.10.0.** P. & P. 6/-. Additional Probes available: R.F. **35/-.** H.V. **42/6.**

COSSOR 1049 DOUBLE BEAM OSCILLOSCOPES

D.c. coupled. Band width 1kc/s. Perfect order. **£25.** Carr. 30/-.

AM/FM SIGNAL GENERATORS

Oscillator Test No. 2. A high quality precision instrument made for the ministry by Airmec. Frequency coverage 20–80Mc/s. AM C.W./FM. Incorporates precision dial, level meter, precision attenuator 1μV-100mV. Operation from 12V d.c. or 0/110/200/250V a.c. Size 12 × 8½ × 9in. Supplied in brand new condition complete with all connectors fully tested. **£45.** Carr. 20/-.

HAMMARLUND SP600J COMMUNICATION RECEIVER. 540 Kc/s–54 Mc/s in 6 bands. FEW ONLY! **£100.**

EDDYSTONE VHF RECEIVERS MODEL 770R. 19–165 Mc/s. Excellent condition. **£150.**

TE-16A Transistorised Signal Generator. 5 ranges 400 kHz–30 mHz. An inexpensive instrument for the handyman. Operates on 9v battery. Wide, easy to read scale. 800 kHz modulation. 5½ × 5½ × 3½. Complete with instructions and leads. **£7.19.6.** P.&P. 4/-.

FIELD TELEPHONES TYPE L
Generator ringing, metal cases. Operates from two 1·5v. batteries (not supplied). Excellent condition. **£4.10.0** per pair. Carr. 10/-.

AUTO TRANSFORMERS

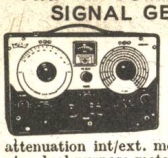
0/115/230v. Step up or step down. Fully shrouded.

150 W.	**£2.2.6,** P. & P. 3/6
300 W.	**£2.19.6,** P. & P. 4/6
500 W.	**£4.10.0,** P. & P. 6/6
1,000 W.	**£6.10.0,** P. & P. 7/6
1,500 W.	**£7.19.6,** P. & P. 8/6
7,500 W.	**£15.10.0,** P. & P. 20/-

G. W. SMITH & CO (RADIO) LTD.

Also see oppos. page

ARF-100 COMBINED AF-RF SIGNAL GENERATOR



A.F. SINE WAVE 20–200,000 c/s. Square wave 20–30,000 c/s. O/P. **HIGH IMP. 21V.** P/P600Ω 3·8 V. P/P. TF 100 kc/s–300 Mc/s. Variable R.F. attenuation int/ext. modulation. Incorporates dual purpose meter to monitor AF output and % mod. on R.F 220/240 V a.c. **£30.0.0.** Carr. 7/6.

TE-20RF SIGNAL GENERATOR

Accurate wide range signal generator covering 120 kc/s–260 Mc/s on 6 bands. Directly calibrated variable R.F. attenuator. Operation 200/240V a.c. Brand new with instruction. **£5.15.0.** P. & P. 7/6. S.A.E. for details.

TE22 SINE SQUARE WAVE AUDIO GENERATORS

Sine: 20c/s to 200 kc/s on 4 bands. Square: 20c/s to 30 kc/s. Output impedance 5,000 ohms. 200/250V. A.C. Supplied brand new and guaranteed with instruction manual and leads. **£16.10.0.** Carr. 7/6.

MARCONI TF142E DISTORTION FACTOR METERS. Excellent condition. Fully tested. **£20.** Carr. 15/-.

LAFAYETTE TE46 RESISTANCE CAPACITY ANALYSER

2pF-2,000 mfd 2 ohms–200 megohms. Also checks impedance, turns ratio, insulation, 200/250V a.c. **Brand New £17.10.0.** Carr. 7/6.

ADVANCE TEST EQUIPMENT

Brand new and boxed in original sealed cartons.

VM.76 **VALVE VOLTMETER R.F. measurements in excess of 100Mc/s and d.c. measurements up to 100V with accuracy of ±2% d.c. range 300 MV to 1kV a.c. range 300MV to 300V RMS. Resistance 0·02–500MΩ. Price £72.**

VM.79 **UHF MILLIVOLT METER. Transistorised. A.c. range 10MV–3V. D.c. current range 0·01μA–0·3MA. Resistance 1 ohm–10 megohms. Price £125.**

H1B **AUDIO SIGNAL GENERATOR. 15c/s–50kc/s. sine or square wave. Price £30.**

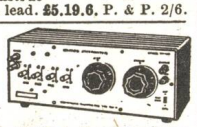
J1B **AUDIO SIGNAL GENERATOR. 15c/s–50kc/s. Price £30.**

TT1S **TRANSISTOR TESTER. £37.10.0. Carriage 10/- per item.**

MODEL ZQM TRANSISTOR CHECKER

It has the fullest capacity for checking on A, B and Ico. Equally adaptable for checking diodes, etc. Spec.: A: 0·7–0·9967. B: 5–200. Ico: 0–50 microamps 0–5 mA. Resistance for diode 200 Ω–1 MΩ. Supplied complete with instructions, battery and lead. **£5.19.6.** P. & P. 2/6.

TE111. DECADE RESISTANCE ATTENUATOR



Variable range 0–111dB. Connections. Unbalanced T and Bridge T. Impedance 600Ω range (0·1dB × 10) + (1dB × 10) + 10 + 20 + 30 + 40dB. Frequency: d.c. to 200kHz (−3dB). Accuracy: 0·05dB. +indication dB × 0·01. Maximum input less than 4W (50V). Built in 600Ω load resistance with internal/external switch. Brand new **£27.10.0.** P. & P. 5/-.

SOLARTRON MONITOR OSCILLOSCOPE TYPE 101

An extremely high quality oscilloscope with time base of 10μ/sec to 20m/sec. Internal Y amplifier. Separate mains power supply 200/250V. Supplied in excellent condition with cables, probe, etc., as received from Ministry. **£8.19.6.** Carr. 30/-.

Latest Catalogue

The latest edition giving full details of a comprehensive range of HI FI EQUIPMENT, COMPONENTS, TEST EQUIPMENT and COMMUNICATIONS EQUIPMENT... . Nearly 200 pages, fully illustrated and detailing thousands of items—many at bargain prices. FREE DISCOUNT COUPONS VALUE 10/-.

SEND NOW—ONLY 7/6 *P&P1/-*

GARRARD

FULL CURRENT RANGE OFFERED, BRAND NEW AND GUARANTEED AT FANTASTIC SAVINGS

SRP22 Stereo	**£5.19.6**	SP25 MKII	**£11.19.6**
*1025 Mono	**£7.10.0**	*SL55	**£11.19.6**
*1025 Stereo	**£7.15.0**	A70 MKII	**£12.10.0**
*2025 Stereo	**£7.19.6**	*SL65	**£14.14.0**
*2025T/C		AP75	**£17.17.0**
Mono/Stereo	**£8.17.6**	401	**£28. 7.6**
*3000 Stereo	**£9.19.6**	SL75	**£28.10.0**

Carriage/insurance 7/6 extra any model. WB4 Bases **£3.19.6.** Perspex covers **£3.10.0.** *Special offer base and cover available for these models at **£4.15.0.** Carr. 5/-. Full range of Garrard accessories available.

LAFAYETTE LA-224T TRANSISTOR STEREO AMPLIFIER

19 transistors, 8 diodes, 1HF music power, 30W at 8Ω. Response 30–20,000 ± 2dB at 1W. Distortion 1% or less. Inputs 3mV and 250mV. Output 3–16Ω. Separate L and R volume controls. Treble and bass control. Stereo phone jack. Brushed aluminium, gold anodised extruded front panel with complementary metal case. Size 10¾ × 3 9/16 × 7 13/16in. Operation 115/230V. A.C. **£28.** Carriage 7/6.

MULTIMETERS *for EVERY purpose!*

TE-51. NEW 20,000Ω/VOLT MULTIMETER with overload protection and mirror scale. 0/6/60/120/1,200V a.c. 0/3/30/60/300/600/3,000V d.c. 0·60μA/12/300mA d.c. 0/60K/6 meg. ohm. **92/6.** P. & P. 2/6.

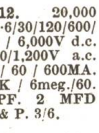
TE-900 20,000Ω VOLT GIANT MULTIMETER 6in. full view meter. 2 colour scale, overload protection. 0/2·5/10/250/1,000/5,000V a.c. 0/25/12·5/10/50/250/1,000/5,000V d.c. 0/50μA/110/100/500mA 10A d.c. 20K/200K/20MΩ. **£15.** P. & P. 5/-.

MODEL AS-100D. 100KΩ/VOLT. 5in., mirror scale. Built-in meter protection. 0/3/12/60/120/300/600/1,200V d.c. 0/6/30/120/300/600V a.c. 0/10μA/6/60/300MA/12 Amp. 0/2K/200K/2M/200MΩ. −20 to +17dB. **£12.10.0.** P. & P. 3/6.

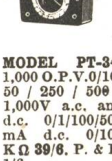
MODEL TE-10A. 20kΩ/Volt, 5/25/50/250/500/2,500 V, d.c. 10/50/100/500/1,000V. a.c. 0/50μA/2·5 mA./250mA. d.c. 0/6K/6 megohm. −20 to +22dB. 10–0, 100 mfd. t 0 0·100–0·1 mfd. **69/6.** P. & P. 2/6.

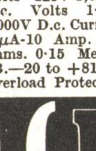
MODEL TE-90 50,000 O.P.V. MIRROR SCALE OVERLOAD PROTECTION 0/3/12/60/300/600/1,200V d.c. 0/6/30/120/300/1,200V d.c. 0·03/6/60/600MA d.c. 16kΩ/160kΩ/1·6/16MΩ. −20 to +63dB. **£7.10.0.** P. & P. 3/-.

MODEL TE 80. 20,000 O.P.V. 0/10/50/100/500/1,000V. a.c. 0/5/25/50/250/500/1,000V d.c. 0·5μA. 5/50/500mA/0/6K/60/K/600K/6 Meg. **£4.17.6.** P. & P. 3/-.



MODEL TE-70. 30,000 O.P.V. 0/3/15/60/300/600/1,200V. d.c. 0/6/30/120/600/1,200V. a.c. 0/30μA/3/30/300mA. 0/16K/160K/1·6M/16megohm **£5.10.0.** P. & P. 3/-.



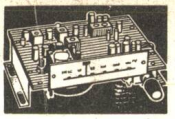


MODEL TE12. 20,000 O.P.V. 0/0·6/30/120/600/1,200/3,000/6,000V d.c. 1/6/30/120/600/1,200V a.c. 0/60μA/6/60/600MA. 0/6K/600K/6meg./60. Megohm 50PF. 2 MFD **£5.19.6.** P. & P. 3/6.

MODEL PT-34. 1,000 O.P.V.0/10/50/250/500/1,000V a.c. and d.c. 0/1/100/500 mA d.c. 0/100KΩ **39/6.** P. & P. 1/6.

LAFAYETTE 57 Range Super 50,000 O.P.V. Multimeter. D.c. Volts 125V-1,000V A.c. Volts 1·5V-1,000V D.c. Current 25μA-10 Amp. Ohms. 0·15 MegΩ dB.—20 to +81dB. Overload Protection. **£12.10.0.** Carr. 3/6.

★ TRANSISTORISED FM TUNER ★



6 TRANSISTOR HIGH QUALITY TUNER, SIZE ONLY 6×4×2¼in. 3 I.F. stages. Double tuned discriminator. Ample output to feed most amplifiers. Operates on 9V battery. Coverage 88–108 Mc/s. Ready built ready for use. Fantastic value for money. **£6.7.6.** P. & P. 2/6. Stereo multiplex adaptors **99/6.**

TRANSISTORISED TWO-WAY TELEPHONE INTERCOM

Operative over amazingly long distances. Separate call and press to talk buttons, 2-wire connection. 1000's of applications. Beautifully finished in ebony. Supplied complete with batteries and wall brackets. **£6.9.6.** P. & P. 3/6.

SINCLAIR EQUIPMENT

Z12 12 watt amplifier, **89/6**
PZ4 Power Supply Unit **89/6**
Stereo 25 Preamp., **£9.19.6**
Q14 Speakers, **£7.19.6**
Micromatic Radio Kit, 49/6. Built **59/6**

NOW IN STOCK IC/10 **59/6** ALL POST PAID

SPECIAL OFFER

Two **Z12** Amps., **PZ4** Power Supply, **Stereo 25** Preamplifier, **£22,** or with two **Q14** speakers, **£37**

NEW SINCLAIR 2000 SYSTEM

35 watt Integrated Amplifier **£29.** Carr. 5/-. Self powered F.M. Tuner. **£25.** Carr. 5/-.

PEAK SOUND PRODUCTS

Full range of Amplifiers, Kits, Speakers in stock.

ECHO HS-606 STEREO HEADPHONES

Wonderfully comfortable. Lightweight adjustable vinyl headband. 6ft. cable and stereo jack plug. 25–17,000 cps. 8 ohm imp. **67/6** P. & P. 2/6.

HOSIDEN DH04S 2-WAY STEREO HEADSETS

Each headphone contains a 2½in woofer and a ⅝in tweeter. Built in individual level controls. 8Ω imp. 25-18,000c/s. with cable and stereo plug. **£5.19.6.** P. & P. 2/6.

RECORDING HEADS

COSMOCORD ¼-track heads. High imp. record/playback **65/-.** Low imp. erase **20/-. MARRIOTT** ¼-track heads. High imp. record/playback **65/-.** Low imp. erase **20/-.** Post extra.

RACAL MA.168 TRANSISTORISED DIVERSITY SWITCH. Brand New Condition **£15.** Carr. 10/-.

AMERICAN TAPE

First grade quality American tapes. Brand new Discount on quantities.

3in. 225ft. L.P. acetate	**3/6**
3½in. 600ft. T.P. mylar	**10/-**
5in. 600ft. std. plastic	**8/6**
5in. 900ft. L.P. acetate	**10/-**
5in. 1,200ft. D.P. mylar	**15/-**
5½in. 1,200ft. L.P. acetate	**12/6**
5½in. 1,200ft. L.P. mylar	**16/-**
5½in. 1,800ft. D.P. mylar	**22/6**
5½in. 2,400ft. L.P. mylar	**39/6**
7in. 1,200ft. std. acetate	**12/6**
7in. 1,800ft. L.P. acetate	**15/-**
7in. 1,800ft. L.P. mylar	**20/-**
7in. 2,400ft. D.P. mylar	**25/-**
7in. 3,600ft. T.P. mylar	**45/-**

Postage 2/-. Over £3 post paid.

MAXELL TAPE CASSETTES

C60. **10/3**; C90. **14/3**; C120. **19/6.** Post extra.

G.W.SMITH & CO.(RADIO) LTD

All Mail Orders to—
147, Church Street, London, W.2
Tel: 01-262 6562
(Trade supplied)

3, LISLE STREET, LONDON, W.C.2 Tel: 01-437 8204
34, LISLE STREET, LONDON, W.C.2 Tel: 01-437 9155
311, EDGWARE ROAD, LONDON, W.2 Tel: 01-262 0387

OPEN 9-6 MONDAY TO SATURDAY (EDGWARE ROAD ½ DAY THURSDAY)

VALUE ALL THE WAY

INTEGRATED CIRCUIT AMPLIFIER

AS USED IN 'P.E.' PROJECTS

Identical encapsulation and pin configuration to the following: SL402-3, IC10 and IC403. Each circuit incorporates a pre-amp and class A.B. Power amp stage capable of delivering up to 3 watts RMS. Fully tested and guaranteed. Supplied complete with circuit details and data. CODED BP.1010. OUR LOWEST PRICE **25**/- each. 10 up **21**/- each.

BI-PAK MONOLITHIC AMPLIFIERS (TO-5 8 lead)

BP709C, Operational amplifier, **15**/- each.
BP701C, Operational amplifier (with Zener output), **12**/6 each.
BP702C, Operational amplifier (with direct output), **12**/6 each.
BP501, Wide band amplifier, **18**/- each.
BP521, Logarithmic wide band amp., **14**/- each.
BP20/C, General purpose amplifier (TO-5 8 lead). (voltage or current amp.), **12**/6 each.
I.C. Operational Amplifier with Zener output. **Type 701C.** Ideal for P.E. Projects. 8 Lead TO-5 case. Full data.

Our price 12/6 each

5 off 11/- each. Large Qty. Prices quoted for.

OTHER MONOLITHIC DEVICES

BP424, Zero voltage switch, **8**/6 each.
This device is a monolithic I.C. that acts as combined threshold detector and trigger circuit for controlling a triac. It is designed to pulse the gate of a thyristor at the point of zero supply voltage, and therefore eliminate radio frequency interference when used with resistive loads.
D13D1 Silicon Unilateral switch **10**/- each.
A Silicon Planar, monolithic integrated circuit having thyristor electrical characteristics, but with an anode gate and a built-in "Zener" diode between gate and cathode. Full data and application circuits available on request.

FAIRCHILD (U.S.A.) RTUL MICROLOGIC INTEGRATED CIRCUITS

Epoxy case T-8-5 lead temp. range 15°C. to 55°C.
UL900, Buffer, **10**/6 each.
UL914, Dual two-input gate, **10**/6 each.
UL923 J-K-flip-flop, **14**/- each.
Complete data and circuits for the Fairchild I.C.'s available in booklet form priced **1**/6.

MULLARD I.C. AMPLIFIERS

TAA243, Operational amplifier, **70**/- each.
TAA263, Linear AF amplifier, **18**/6 each.
TAA293, General purpose amplifier, **21**/- each.

CA3020 RCA (U.S.A.) LINEAR INTEGRATED CIRCUITS

Audio Power Amplifier, **30**/- each.
Owing to the mass of I.C. printed matter often required by customers in connection with the I.C.'s themselves we ask you to help us in the cost of reproducing this literature by adding 2s. towards same. This is only necessary when a number of different sheets are required.

Sil. trans. suitable for P.E. Organ. Metal TO-18 Eqvt. ZTX300 1/- each. Any Qty.

AD161 *NPN*
AD162 *PNP*

MATCHED COMPLEMENTARY PAIRS OF GERM. POWER TRANSISTORS.

For mains driven output stages of Amplifiers and Radio receivers.

OUR LOWEST PRICE OF **12**/6 *PER PAIR*

HIGH POWER SILICON PLANAR TRANSISTORS. TO-3.

TEXAS 2S034	NPN
VCB100	Ic 4A
	fT. 15M/cs
VCE100	Ptot. 40W
VEB8	hFE(min.)
15/- each	60

2N3055 **12**/6 each.

FREE

One 10/- Pack of your own choice free with orders valued £4 or over.

NPN DIFFUSED SILICON PHOTO-DUO-DIODE TYPE IS701 (2N2175) for Tape Readout, high switching and measurement indicators, 50V, 250mW. OUR PRICE **10**/- EACH, 50 OR OVER **8**/6 EACH, FULL DETAILS.

LOW COST F.E.T.s

Fully Tested, Guaranteed Parameters equit. to 2N3819, MPF102, 2N-5459. 1-24 **7**/6 each; 25-99 **6**/3 each; 100 up **5**/6 each. Coded FE19. Full data sent. TO-72 case.

TRIACS

2A, 400 PIV, TO-5 case, **20**/- each; 6A, 400 PIV, TO-66 case, **25**/- each; 10A, 400 PIV, TO-48 case, **35**/- each. New and fully tested.

KING OF THE PAKS — Unequalled Value and Quality

SUPER PAKS

NEW BI-PAK UNTESTED SEMICONDUCTORS

Satisfaction GUARANTEED in Every Pak, or money back.

Pak No.		
U1	120 Glass Sub-min. General Purpose Germanium Diodes	10/-
U2	60 Mixed Germanium Transistors AF/RF	10/-
U3	75 Germanium Gold Bonded Diodes sim. OA5, OA47	10/-
U4	40 Germanium Transistors like OC81, AC128	10/-
U5	60 200mA Sub-min. Sil. Diodes	10/-
U6	40 Silicon Planar Transistors NPN sim. BSY95A, 2N706	10/-
U7	16 Silicon Rectifiers Top-Hat 750mA up to 1,000V	10/-
U8	50 Sil. Planar Diodes 250mA OA/200/202	10/-
U9	20 Mixed Volts 1 watt Zener Diodes	10/-
U11	30 PNP Silicon Planar Transistors TO-5 sim. 2N1132	10/-
U13	30 PNP-NPN Sil. Transistors OC200 & 2S104	10/-
U14	150 Mixed Silicon and Germanium Diodes	10/-
U15	30 NPN Silicon Planar Transistors TO-5 sim. 2N697	10/-
U16	10 3-Amp Silicon Rectifiers Stud Type up to 1000 PIV	10/-
U17	30 Germanium PNP AF Transistors TO-5 like ACY 17-22	10/-
U18	8 6-Amp Silicon Rectifiers BYZ13 Type up to 600 PIV	10/-
U19	30 Silicon NPN Transistors like BC108	10/-
U20	12 1·5-amp Silicon Rectifiers Top-Hat up to 1,000 PIV	10/-
U21	30 A.F. Germanium alloy Transistors 2G300 Series & OC71	10/-
U23	30 Madt's like MAT Series PNP Transistors	10/-
U24	20 Germanium 1-amp Rectifiers GJM up to 300 PIV	10/-
U25	25 300Mc/s NPN Silicon Transistors 2N708, BSY27	10/-
U26	30 Fast Switching Silicon Diodes like 1N914 Micro-min	10/-
U28	Experimenters' Assortment of Integrated Circuits, untested. Gates, Flip-Flops, Registers, etc., 8 Assorted Pieces	20/-
U29	10 1 amp SCR's T0-5 can up to 600 PIV. CRS1/25-600	20/-
U30	15 Plastic Silicon Planar trans. NPN 2N2924-2N2926	10/-
U31	20 Sil. Planar NPN trans. low noise Amp 2N3707	10/-
U32	25 Zener diodes 400mW D07 case mixed Volts, 3–18	10/-
U33	15 Plastic case 1 amp Silicon rectifiers IN4000 series	10/-
U34	30 Sil. PNP alloy trans. TO-5 BCY26, 2S302/4	10/-
U35	25 Sil. Planar trans. PNP TO-18 2N2906	10/-
U36	25 Sil. Planar NPN trans. TO-5 BFY50/51/52	10/-
U37	30 Sil. alloy trans. SO-2 PNP, OC200 2S322	10/-
U38	20 Fast Switching Sil. trans. NPN, 400Mc/s 2N3011	10/-
U39	30 RF Germ. PNP trans. 2N1303/5 TO-5	10/-
U40	10 Dual trans. 6 lead TO-5 2N2060	10/-
U41	30 RF Germ. trans. TO-1 OC45 NKT72	10/-
U42	10 VHF Germ. PNP trans. TO-1 NKT667 AF117	10/-

Code Nos. mentioned above are given as a guide to the type of device in the Pak. The devices themselves are normally unmarked

QUALITY-TESTED PAKS

6	Matched Trans. OC44/45/81/81D	10/-
20	Red Spot AF Trans. PNP	10/-
16	White Spot RF Trans. PNP	10/-
5	Silicon Rects. 3 A 100-400 PIV	10/-
2	10 A Silicon Rects. 100 PIV	10/-
2	OC1 140 Trans. NPN Switching	10/-
1	12 A SCR 100 PIV	10/-
3	Sil. Trans. 2S303 PNP	10/-
4	Zener Diodes 240mW 3-12V	10/-
3	200 Mc/s Sil. Trans. NPN BSY26/27	10/-
3	Zener Diodes 1W 33V 5% Tol.	10/-
4	High Current Trans. OC42 Eqvt.	10/-
2	Power Transistors 1 OC26 1 OC35	10/-
5	Silicon Rects, 400 PIV 250mA	10/-
4	OC75 Transistors	10/-
1	Power Trans. OC20 100V	10/-
10	OA202 Sil. Diodes Sub-min.	10/-
2	Low Noise Trans. NPN 2N929/30	10/-
1	Sil. Trans. NPN VCB 100 ZT86	10/-
8	OA81 Diodes	10/-
4	OC72 Transistors	10/-
4	OC77 Transistors	10/-
4	Sil. Rects. 400 PIV 500mA	10/-
5	GET884 Trans. Eqvt. OC44	10/-
5	GET883 Trans. Eqvt. OC45	10/-
2	2N708 Sil. Trans. 300Mc/s NPN	10/-
3	GT31 LF Low Noise Germ Trans.	10/-
6	IN914 Sil. Diodes 75 PIV 75mA	10/-
8	OA95 Germ. Diodes Sub-min. IN69	10/-
3	NPN Germ. Trans. NKT773 Eqvt.	10/-
2	OC22 Power Trans. Germ.	10/-
2	OC25 Power Trans. Germ.	10/-
4	AC128 Trans. PNP High Gain	10/-
4	AC127/128 Comp. pair PNP/NPN	10/-
3	2N1307 PNP Switching Trans.	10/-
7	CG62H Germ. Diodes Eqvt. OA71	10/-
3	AF116 Type Trans.	10/-
12	Assorted Germ. Diodes Marked	10/-
4	AC126 Germ. PNP Trans.	10/-
4	Silicon Rects. 100 PIV 750mA	10/-
3	AF117 Trans.	10/-
7	OC81 Type Trans.	10/-
3	OC171 Trans.	10/-
5	2N2926 Sil. Epoxy Trans.	10/-
7	OC71 Type Trans.	10/-
2	2S701 Sil. Trans. Texas	10/-
3	12 Volt Zener 400mW	10/-
2	10 A 600 PIV Sil. Rects. 1845R	10/-
3	BC108 Sil. NPN High Gain Trans.	10/-
1	2N910 NPN Sil. Trans. VCB 100	10/-
2	1000 PIV Sil. Rect. 1·5 A R53310 AF	10/-
3	BSY95A Sil. Trans. NPN 200Mc/s	10/-
3	OC200 Sil. Trans.	10/-
2	GET880 Low Noise Germ. Trans.	10/-
1	AF139 PNP High Freq. Trans.	10/-
3	NPN Trans. 1 ST141 & 2ST140	10/-
4	Madt's 2 MAT100 & 2MAT120	10/-
3	Madt's 2 MAT101 & 1 MAT121	10/-
4	OC44 Germ. Trans. AF	10/-
3	AC127 NPN Germ. Trans.	10/-
1	2N3906 Sil. PNP Trans. Motorola	10/-
2	Sil. Power Rects. BYZ13	15/-
1	Sil. Power Trans. NPN 100Mc/s. TK201A	15/-
6	Zener Diodes 3-15V Sub-min.	15/-
2	2N1132 PNP Epitaxial Planar Sil.	10/-
3	2N697 Epitaxial Planar Trans. Sil.	15/-
4	Germ. Power Trans. Eqvt. OC16	15/-
1	Unijunction Trans. 2N2646	15/-
2	Sil. Trans. 200Mc/s 60Vcb ZT83/84	15/-
1	Tunnel Diode AEY11 1050 Mc/s	15/-
2	2N2712 Sil. Epoxy Planar HFE225	15/-
8	BY100 Type Sil. Rects.	20/-
25	Sil. and Germ. Trans. Mixed, all marked, New	30/-

LUCAS 35A SIL. RECTS. Branded. 400 PIV. Special Price, stud type, flying lead, **22**/6 each.

SPECIAL OFFER S.C.R.s 3A, 400 PIV similar to CRS3/40AF—BYT97400R, 2N1777, **10**/- each; 25–99, **9**/- each; 100 up **8**/6 each.

NPN SILICON PLANAR BC107/8/9, **2**/- each; 50–99,, **1**/10; 100 up, **1**/8 each; 1,000 off, **1**/6 each. Fully tested and coded TO–18 case.

PNP SIL. PLASTIC TRANS. Similar to 2N3702, uncoded but fully tested, **1**/6 each; 25–99, **1**/3 each; 100 up, **1**/- each.

"TRANSISTOREN" Transistor equit. book. New Dutch edition printed in English. Equit. to European, American and Japanese Trans. 190 pages, **15**/- each.

SPECIAL CLEARANCE OF GET120 PNP Med. Power Trans. complete with heatsink, Mica washers, etc. similar to NKT303, I.C. 2A, 5W, **2**/6 each; 12 up, **2**/- each.

BRAND NEW TEXAS GERM. TRANS. Coded and Guaranteed

Pak No.		EQVT.	
T1	8 2G371B	OC71	10/-
T2	8 2G374	OC75	10/-
T3	8 2G3744A	OC81D	10/-
T4	8 2G381A	OC81	10/-
T5	8 2G382T	OC82	10/-
T6	8 2G344A	OC44	10/-
T7	8 2G345B	OC45	10/-
T8	8 2G378	OC78	10/-
T9	8 2G399A	2N1302	10/-
T10	8 2G417	AF117	10/-

FULL RANGE OF ZENER DIODES VOLTAGE RANGE 2-16V.
400mW (DO-7 Case).....**2**/6 each
1-5W (Top-Hat) .....**3**/6 each
10W (SO-10 Stud) .....**5**/- each
All fully tested 5% tol. and marked state voltage required.

SILICON HIGH VOLTAGE RECTIFIERS

10 Amp 3 kV (3000 PIV). Stud type with flying leads **16**/- each

2N2060 NPN SIL. DUAL TRANS. CODE D1699 TEXAS. OUR PRICE **5**/- each.

120 VCB NIXIE DRIVER TRANSISTOR Sim. BSX21 & C407. 2N1893 FULLY TESTED AND CODED ND120. 1-24 **3**/6 each. TO-5 NPN 25 up **3**/- each.

PLEASE NOTE. To avoid any further Increased Postal Charges to our Customers and enable us to keep our "By Return Postal service" which is second to none, we have re-organized and streamlined our Despatch Order Department and we now request you to send all your orders together with your remittance, direct to our Warehouse and Despatch Department, postal address: **BI-PAK SEMICONDUCTORS, Despatch Dept., P.O. BOX 6, WARE, HERTS.** Postage and packing still 1/- per order. Minimum order 10/-.

FET'S

2N 3819	10/-
2N 3820	25/-
MPF105	8/-
OCP71 Type	8/6

SIL. RECTS. TESTED

PIV	750mA	3A	10A	30A
50	1/-	2/9	4/3	9/6
100	1/3	3/3	4/6	15/-
200	1/9	4/-	4/9	20/-
300	2/3	4/6	6/6	22/-
400	2/6	5/6	7/6	25/-
500	3/-	6/-	8/6	30/-
600	3/3	6/9	9/-	37/-
800	3/6	7/6	11/-	40/-
1000	5/-	9/3	12/6	50/-
1200	6/6	11/6	15/-	—

TESTED SCR'S

PIV	1A	7A	16A	30A
25	—	7/6	—	30/-
50	7/6	8/6	10/6	35/-
100	8/6	10/-	15/-	45/-
200	12/6	15/-	20/-	55/-
300	15/-	20/-	25/-	—
400	17/6	25/-	35/-	80/-
500	30/-	40/-	45/-	95/-
600	—	40/-	50/-	—

CADMIUM CELLS

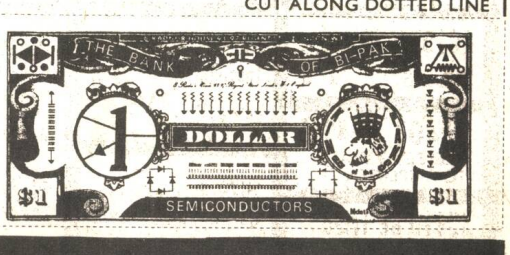
ORP12 **8**/6
ORP60, ORP61 **8**/- each

UJT's

UT46, Eqvt. **2N2646,** Eqvt. TI843. BEN3000 **7**/6 each
25–99 **5**/-
100 up **4**/-

Seasons Greetings from BI-PAK SEMICONDUCTORS and a Xmas "GIFT DOLLAR" value 5/- redeemable with all orders of One Pound or over. Cash in now and save 5/- on your next order. Not valid after 31st January 1970.

CUT ALONG DOTTED LINE



KING OF THE PAKS **BI-PAK** GUARANTEE SATISFACTION OR **MONEY BACK**

L.S.T. ELECTRONIC COMPONENTS LTD.

AA119	2/-	BC142	15/-	BYY25	31/9	NKT217	13/-	OC24	10/-	2G302	3/9	2N2369	5/6
AAY11	2/1	BC143	15/-	BYY142	3/9	NKT218	5/3	OC25	6/9	2G339A	5/-	2N2369A	6/-
AAZ12	17/6	BC147	4/7	BYZ10	9/-	NKT221	5/6	OC26	12/-	2G374	5/-	2N2432	58/4
AC107	14/6	BC148	3/3	BYZ12	6/-	NKT222	4/-	OC28	12/-	2G381	5/-	2N2477	18/-
AC126	6/6	BC149	4/7	BYZ13	59/-	NKT223	6/-	OC29	15/-	2G371	4/-	2N2484	14/-
AC127	6/-	BC154	12/-	C106F1	9/-	NKT223A	3/6	OC35	9/6	2G371B	3/-	2N2613	8/3
AC127Z	8/6	BCY10	7/6	C111	18/-	NKT224	4/6	OC36	13/-	2N174	24/-	2N2614	7/6
AC128	4/-	BCY12	7/6	C111E	12/-	NKT225	3/6	OC41	3/6	2N301	8/-	2N2646	10/-
AC151	8/8	BCY30	9/2	C400	9/-	NKT226	10/-	OC42	4/-	2N109	13/6	2N2894	13/9
AC176	7/6	BCY31	9/2	C426	8/3	NKT227	5/6	OC43	4/-	2N217	7/6	2N2904A	15/6
AC187	12/-	BCY32	20/5	C444	9/8	NKT228	6/-	OC44	3/-	2N352	15/-	2N2924	5/-
AC188	12/-	BCY33	4/11	CG6E	4/-	NKT261	4/3	OC45	3/-	2N386	12/-	2N2925	5/6
ACY17	5/9	BCY34	6/6	CG63	2/-	NKT270	3/6	OC70	3/-	2N384	17/-	2N3036	39/2
ACY18	3/6	BCY38	8/-	D13T1	10/-	NKT271	5/-	OC71	3/-	2N385A	15/-	2N3053	8/-
ACY19	4/5	BCY39	28/-	EA403	3/6	NKT272	5/-	OC72	4/6	2N388A	15/-	2N3054	15/-
ACY20	3/7	BCY40	16/-	EC401	5/-	NKT273	4/-	OC73	3/-	2N370	15/-	2N3055	15/-
ACY21	4/-	BCY42	4/-	EC402	4/8	NKT274	4/-	OC74	3/-	2N404	4/3	2N3394	4/-
ACY22	2/11	BCY43	8/-	EB383	3/6	NKT275	5/-	OC76	2/6	2N410	6/-	2N3702	3/6
ACY30	9/-	BCY54	17/4	GET102	6/-	NKT276	3/6	OC77	9/3	2N456A	20/-	2N3703	3/3
AD140	15/-	BCY70	4/4	GET103	4/6	NKT279A	2/6	OC81D	3/-	2N458A	33/-	2N3704	3/9
AD149	11/8	BCY71	8/8	GET104	5/-	NKT281	5/-	OC81	4/6	2N511A	50/3	2N3705	3/4
AD161	6/-	BCY72	4/8	GET105	8/-	NKT301	5/8	OC82	4/6	2N513A	118/5	2N3706	3/10
AD162	6/-	BCY87	86/9	GET114	5/-	NKT302	11/2	OC82D	3/-	2N514B	192/-	2N3707	4/-
ADT140	12/6	BCZ11	10/8	GET875	6/-	NKT303	10/2	OC83	4/-	2N599	12/-	2N3708	2/5
AF102	18/-	BD119	15/-	GET573	7/6	NKT304	9/8	OC84	4/-	2N601	5/-	2N3709	3/9
AF114	4/4	BD121	18/6	GMO290	13/5	NKT351	8/-	OC123	7/-	2N657	15/4	2N3710	3/10
AF115	4/4	BD123	23/6	GMO378	11/-	NKT352	7/6	OC139	8/-	2N696	5/3	2N3711	3/3
AF116	4/4	BD124	15/-	GEX45/1	4/-	NKT402	24/-	OC140	12/-	2N697	5/3	2N3819	8/-
AF117	4/4	BF152	13/6	K8/15	4/-	NKT403	16/-	OC169	6/-	2N698	4/6	2N3820	18/9
AF118	16/6	BF154	9/-	K8/30	9/-	NKT404	13/8	OC170	4/-	2N706	3/-	2N3826	6/-
AF124	6/-	BF159	15/-	K3/50	8/3	NKT405	15/-	OC171	6/-	2N706A	3/-	2N3906	7/6
AF126	3/9	BF163	9/-	MAT100	5/-	NKT451	13/8	OC200	6/3	2N708	4/-	2N4037	18/-
AF127	4/-	BF167	6/6	MAT101	5/6	NKT452	13/4	OC201	10/-	2N711	7/6	2N4058	7/9
AFI39	8/-	BF173	6/2	MAT120	5/-	NKT453	12/-	OC202	18/10	2N711A	7/6	2N4284	3/-
				MAT121	5/6							2N4285	3/-

PRICES FOR QUANTITIES IN EXCESS OF 100 PIECES ON APPLICATION

FIRST GRADE + FAST SERVICE

When enquiring for types not listed please enclose a STAMPED ADDRESSED ENVELOPE

AFI81	12/-	BF178	14/-	ME4103	6/-	NKT674	6/-	OC203	8/3	2N715	7/6	2N4286	3/-
AFI86	11/-	BF179	12/-	MJE520	15/-	NKT675	5/-	OC204	8/-	2N716	7/6	2N4287	3/-
AF239	12/-	BF180	6/-	MPF102	9/-	NKT676	5/-	OC205	9/-	2N718	7/2	2N4288	3/-
AFZ11	14/-	BF181	7/-	MPF103	9/-	NKT677	5/-	OC206	10/6	2N743	5/-	2N4289	3/-
AFZ12	11/9	BF184	7/6	MPF104	9/-	NKT703	3/6	OC207	7/6	2N744	5/6	2N4290	3/-
ASY26	4/5	BFX13	4/10	MPF105	9/-	NKT713	7/6	ORP12	9/6	2N753	5/-	2N4291	3/-
ASY27	6/-	BFX29	8/-	MPS3638	6/-	NKT773	6/-	ORP60	8/-	2N863	12/-	2N4292	3/-
ASY28	4/5	BFX44	6/5	MJ480	21/-	NKT774	5/4	ORP61	8/-	2N911	7/6	2N4303	15/-
ASY29	6/-	BFX87	6/-	MJ481	27/-	NKT0013	12/6	ORP63	9/-	2N914	4/3	2N4871	6/9
AS2221	11/-	BFY50	4/6	MJ491	30/3	NKT10419	13/-	ORP93	24/-	2N918	15/-	2S002	15/-
ATZ10	40/-	BFY51	3/9	NKT121	10/11	NKT10519	12/6	OC309	12/-	2N929	5/6	2S004	23/-
AUY10	39/6	BFY52	4/6	NKT122	7/9	NKT10339	10/3	P346A	6/-	2N930	6/8	2S017	15/-
AFY19	16/10	BFY53	3/2	NKT123	6/2	NKT10429	11/3	RAS310AF	6/-	2N1131	9/6	2S018	12/6
BA110	6/-	BSX20	3/4	NKT124	9/8	NKT20329	12/6	RAS508AF	15/-	2N1132	7/6	2S020	15/-
BA111	6/-	BSX21	8/-	NKT125	6/2	NKT16229	11/-	ST2	9/9	2N1143	26/2	2S024	25/-
BA112	18/-	BSY27	4/-	NKT127	5/8	OA5	3/8	ST140	3/-	2N1177	14/-	2S034	12/6
BA115	2/8	BSY95A	3/4	NKT128	6/-	OA10	6/-	ST141	5/-	2N1302	4/6	2S102	10/-
BA130	3/-	BTX39/		NKT129	5/10	OA47	1/6	TIS44	1/7	2N1303	4/6	2S104	12/6
BAY31	2/6	600R	120/-	NKT141	6/11	OA70	1/6	TIS43	6/9	2N1304	5/-	2S301	7/7
BAY38	3/-	BTX40/		NKT142	5/10	OA73	1/6	U23AAA	5/-	2N1305	5/-	2S302	6/-
BC107	2/9	600R	120/-	NKT143	5/4	OA79	1/6	V205	20/-	2N1306	6/6	2S304	15/-
BC108	2/9	BTY87/		NKT144	8/-	OA81	1/6	X405A	9/3	2N1307	6/6	2S320	12/6
BC109	2/9	150R	31/-	NKT152	3/4	OA85	1/6	XA102	6/-	2N1308	8/-	2S322	8/-
BC113	5/-	BTY91/		NKT161	5/8	OA90	1/6	XA702	15/-	2N1309	8/-	2S701	10/-
BC114	7/5	300R	47/-	NKT162	5/8	OA91	1/6	ZT22	19/-	2N1507	4/8	2S702	12/-
BC115	7/11	BY100	5/-	NKT163	5/4	OA95	1/6	ZT86	27/6	2N1613	6/6	2S711	23/3
BC116	9/-	BY125	3/6	NKT164	5/4	OA200	2/-	ZT2270	19/6	2N1496	34/6	2S712	30/3
BC118	5/-	BYX10	3/-	NKT165	5/8	OA202	2/-	IN23A	20/-	2N1711	7/6	2S733	9/9
BC125	12/-	BYX36/150	2/6	NKT211	6/-	OA210	6/4	IN34A	4/-	2N2147	17/-	40361	13/3
BC126	12/-	BYX36/300	2/10	NKT212	6/-	OA211	9/-	IN60	4/-	2N2148	12/6	40362	16/3
BC134	5/-	BYX36/600	3/8	NKT213	6/-	OC19	5/-	IN64	4/-	2N2160	14/9	ZT32	19/-
BC136	7/11	BYY21	25/-	KNT214	4/-	OC20	33/-	IN82A	9/6	2N2218	12/-	ZT86	27/6
BC137	8/6	BYY23	26/3	NKT215	4/-	OC22	13/-	IN87A	4/6	2N2243	23/7	ZT2270	19/6
BC138	12/-			NKT216	10/5	OC23	15/-	IN191	5/-	2N2368	6/6		
								1S44	1/6				

COMPONENTS

SKELETON PRESET POTS. 20% Tol. Linear. Low noise. Available in sub-miniature or standard size, horizontal or vertical. 100, 250, 500, 1k, 2.5k, 5k, 10k, 25k, 50k, 100k, 250k, 500k, 1 Meg, 2.5 Meg, 5 Meg. NEW PRICE: 1/- each or any selection of 12 pieces 10/-.

ELECTROLYTIC CAPACITORS (Mullard). −10% to +50% tol. Subminiature (all values in µF).

4V	8	32	64	125	250	400
6.4V	6.4	25	50	100	200	320
10V	4	16	32	64	125	200
16V	2.5	10	20	40	80	125
25V	1.6	6.4	12.5	25	50	80
40V	1	4	8	16	32	50
64V	0.64	2.5	5	10	20	32
Price	1/6	1/3	1/2	1/-	1/1	1/2

MIN. POLYESTER CAPACITORS. Printed circuit type 250 Vdc working. 0.01, 0.015, 0.022, 7d each; 0.033, 0.047, 8d each; 0.068, 0.10, 9d each.

VEROBOARD 0.15" Matrix FLUX COATED
2½ × 3¾", 3/3. 2½ × 5", 3¾ × 3¾", 3/11. 3¾ × 5", 5/6. 3¾ × 18", 18/-. BARGAIN PACK of 36 square inches all good size pieces only 10/- pack.

VEROBOARD 0.1" Matrix, 3¾ × 2½", 3/9.

VEROPINS for 0.15", 36 pieces 3/-.

VER CUTTER 9/- (including free sample pieces).

S-DeCs Single "DeC" with accessories and project manual .. 29/6
"2-DeC" kit contains two "DeCs" component tray accessories, instruction book, all packed in attractive plastic box 69/6
"4-DeC" kit contains four "DeCs", accessories, manual, etc. 117/6

BOOKS FROM STOCK
New RCA Hobby Circuits Manual — dozens of interesting projects. Order HM90 .. .. 24/-
NEW!! "110 Semiconductor Projects" by R. M. Marston 25/-
General Electric Transistor Manual, 660 pages of data and circuits 29/6
NEW!! RCA Manual, 657 pages, SCR'S, Transistors, Diodes and Circuits. Still only .. 28/- + P. & P.
Designers' Guide to British Transistors. Excellent data book lists over 1,000 common types plus Computer-selected substitution chart 25/-
(ADD 2/6 POST & PACKING FOR ALL BOOKS)

NEONS
Signal neons for many types of circuit, type "N" Price 1/6 each or 16/- dozen.

HEATSINKS. Suitable for 2 × OC35, etc. As used in commercial equipment. Type 10D 6/-

ALUMINIUM CHASSIS
6 × 4 × 2½" with reinforced corners 6/9 each (P & P 1/6). Ally panel to fit 1/6. Paxolin panel to fit 2/-. Many other sizes in stock up to 12 × 8 × 2½" (see catalogue).

ZENER DIODES. 400mW 10% Tolerance. Complete range preferred values 3 volt to 30 volt, each .. 3/6

SOLAR CELLS

B2M 0.2–0.4 volts @ 2mA Selenium type ..	.. 12/6
B3M 0.2–0.4 volts @ 1½–2½mA Selenium type	.. 15/-
S1M 0.3–0.4 volts @ 10–16mA Silicon ..	.. 19/-
S4M 0.3–0.4 volts @ 25–40mA Silicon ..	.. 33/6

2N3819 Texas FET **8/-**
25+6/9 100+5/9

2N4871 MOTOROLA Unijunction **6/9**
25+5/9 100+4/9

2N3055 115 WATT POWER **15/-**
25+13/- 100+11/-

56CAY Gallium Arsenide Infra-Red emitter
29/6 each. (Incl. data)

BC107/8/9 Planars 2/9

SL403 49/6
PLESSEY 3 WATT I.C. AMPLIFIER

SC41D GE Triac
400piv 6amp **37/6**

µ LOGIC

	1-6	7-11	12+
uL900	9/9	9/-	8/-
uL914	9/9	9/-	8/-
uL923	13/-	12/-	11/-

Five Page Data article 2/6
Larger quantity prices (100+ and 1,000+) on application.

BF180 MULLARD UHF AMPLIFIER **6/-**
25+4/11 100+4/3

2N2614 RCA LOW NOISE AUDIO 4/9
25+4/- 100+3/-

CRS3/40AF STC/ITT Thyristor 12/6
400piv 3Amp
25+11/- 100+10/3

2N2926 LOW COST NPN PLANAR **2/-**
25+1/8 100+1/6

SILICON RECTIFIERS

PIV	200mA	750mA	2 Amp	10 Amp
50	6d	1/-	2/3	—
100	9d	1/6	2/3	4/6
200	1/3	2/-	2/9	5/-
400	—	2/6	4/-	8/-
600	—	3/-	4/6	9/6
800	—	3/9	5/-	11/3
1000	—	6/-	6/6	14/-

THYRISTORS-SCRs

PIV	1A	3A	10A	30A	100A
50	7/6	9/-	7/6	25/-	20/-
100	—	10/-	10/-	30/-	22/-
200	8/6	—	12/6	42/-	35/-
300	—	11/-	—	51/-	—
400	9/6	12/6	15/-	60/-	45/-
600	—	—	20/-	84/-	120/-
800	—	—	—	—	—

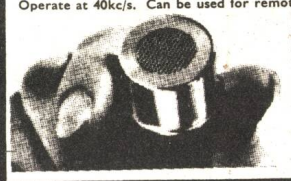
NEW SPECIAL ITEMS!!

40602—	Dual Gate MOS-FET	**9/- each**
L14B—	Photo-Darlington Amplifier	**26/6**
MGA100—	Gallium Arsenide Infra Red Light Source	**35/-**
31F2—	Infra Red Detector Diode	**28/6**
3N84—	Silicon Controlled Switch	**29/6**
TAA320—	Monolithic IC with MOS-FET input followed by Bi-Polar transistor	**13/6**

Data sheets 1/- on request—**free** with above items.

ULTRASONIC TRANSDUCERS

Operate at 40kc/s. Can be used for remote control systems without cables or electronic links. Type 1404 transducers can transmit and receive.



FREE: With each pair our complete transmitter and receiver circuit.
PRICE
£5.18.0 Pair
(Sold only in pairs)

Prices quoted are current at time of going to press and may be subject to variation.
Semiconductors offered bear Manufacturers' original markings and are subject to our full replacement guarantee if not to published specifications.
WE DO NOT offer "Re-marked" Semiconductors.
Our 1969/70 Catalogue is available FREE on request.
Please enclose a stamped addressed envelope with any queries.
Quantity Prices on application.
Retail: Cash with order, please.
Trade: Please furnish usual references if Credit facilities required.
Post & Packing 1/- per order (FIRST CLASS).

MAIL ORDER DEPT. & RETAIL SHOP:—
LST, 7 Coptfold Road, Brentwood, Essex
Telephone: 226470/1 (Sales Department)
EXPORT ENQUIRIES PARTICULARLY WELCOME
GIRO No. 388-3159

★ A FEW EXAMPLES!
★ QUANTITY DISCOUNTS!
★ GUARANTEED GOODS!

MODULES with instructions

ADASTRA Electric E1315 organ, 22/6; E1316 Code oscillator, 22/6; E1317 Wireless code oscillator, 22/6; E1318 Dual lamp flasher, 22/6.

Jason KITS

FANTASTICALLY POPULAR

★ TAPE ★

We offer you fully tensillised polyester/mylar and P.V.C. tapes of identical quality hi-fi, wide range recording characteristics as top grade tapes. Quality control manufacture. They are truly worth a few more coppers than acetate, sub-standard, jointed or cheap imports. TRY ONE AND PROVE IT YOURSELF.

Standard Play			Long Play		
3in.	150ft.	2/3	3in.	225ft.	2/9
4in.	300ft.	4/6	4in.	450ft.	5/6
5in.	600ft.	7/6	5in.	900ft.	10/6
5½in.	900ft.	10/6	5½in.	1,200ft.	13/–
7in.	1,200ft.	12/6	7in.	1,800ft.	18/6
Double Play			Triple Play		
3in.	300ft.	4/–	4in.	900ft.	13/–
4in.	600ft.	8/–	5in.	1,800ft.	25/–
5in.	1,200ft.	15/–	5½in.	2,400ft.	34/–
5½in.	1,800ft.	19/6	7in.	3,600ft.	44/–
7in.	2,400ft.	27/–	Quadruple Play		
Postage 1/– reel.			3in.	600ft.	8/6

Post Free less 5% on three reels.
Quantity and Trade enquiries invited.
NOTE: *Large tape stocks at all branches.*

V.H.F. F.M. TUNER HEADS

GORLA. The famous complete continental F.M. tuning heart in dye cast case complete with ECC85 valve (I.F.10·7 Mc/s) and tuning cord 19/–
FERGUSON. Ditto size 2 × 2 × 3in, screened case with ECC85 valve 17/6
EHRCORDER. Tape recorder, 4 transistor complete with tape mike, terrific value £5.19.0
HONEYTONE. As above, but superior finish £6.19.0
EAGLE. TE188 Signal Generator all wave, large size, super accuracy, big saving ..... 17 gns.

AMPLIFIERS

SINCLAIR PACKAGE DEAL. 2 × Z12 amps., PZ4 power supply, Stereo 25 pre-amp. £21
MINET. 3–4W AC amplifier chassis—sacrificed price £3.10.0
VALVE RECORD PLAYER AMPLIFIERS. 4W output with 2 valves UY85, UL84 ..... 39/–
DITTO high gain UCL82 valve 45/–

RECEIVERS

AIWA. AR813 4-band large radio L/M/S1/S2, super snip ..... 12 gns.
WIEN PILOT II. Aircraft/MW receiver ..... 11 gns.
ERRES. 4-band L/M/S/FM large type wooden cases, 5in. heavy speaker, car socket—bargain offer .... 12 gns. (normal value approx. 25 gns.!!)
FMT640 F.M. TUNER. High sensitivity, 2uV, high fidelity, response 20-20000 cps. tuning meter, AFC built-in power pack, attractive plinth, provisioned for multi-plex (RRP over £30) Super snip ..... 23 gns.

BARGAIN PARCELS

OUR SELECTION—
100 MIXED RESISTORS. ¼-3W wide selection, standard carbon types, good quality 6/–
100 MIXED CONDENSERS. 5pf. to 25 mfd. ceramic silver mica, paper, listed at £ £ £'s 9/6
100 MIXED HI-STAB. RESISTORS. Wellyn 1% to 5% 10 ohms to 2 Megohms, range ¼–1W, ideal quality amps., meters, etc. 9/6
25 MIXED TAG STRIPS. 2-way to 13-way, with feet 3/9
25 MIXED ELECTROLYTICS. H.T., bias and transistor types 7/6
CONNECTING WIRE. Coloured, PVC insulated, 5 coils of 25ft. each 5/–
TRANSISTOR KITS. (Standard superhet sets) **NEWMARKET.** 6 transistors and 1 diode complete, consisting: mixer, 2 i.f.'s, detector, 1 a.m. and 2 P/P outputs in maker's pack, only 12/6
EAGLE. TRK. 6 as above but with addition of a thermistor. Greatly reduced 15/–

MIXED BARGAIN PARCELS ★★★

Selected from variable condensers, I.F. coils, loudspeakers plugs, sockets, knobs, potentiometers, condensers, resistors, nuts, bolts, cabinet fittings, switches, valves, transformers, lamps, complete p.c. boards, chokes, rectifiers, transistors, etc., etc. OFFERED at a small fraction of list value. DUE TO HEAVY DEMAND, we now pack them in several sizes—BE AMAZED!!—TRY ONE NOW: 3lb. parcel (post 3/–) 9/–; 7lb. parcel (post 5/–), 17/6; 14lb. parcel (post 6/6), 29/–.

FANTASTIC BARGAIN OFFER

PARCELS OF POTENTIOMETERS
Twenty Five mixed types, our selection, from ganged, presets, switched, un-switched, tandems, log. and lin., at approx. 4½d. each! . . .9/6.

CABINETS, CHASSIS

AUTOCHANGE RECORD PLAYER CABINETS (carriage 6/–).
SEAFIRLE. Size 17½ × 15½ × 7½in. standard lift-up lid type, cut out for 7 × 4in. speaker and BSR VA25 Super Slim, and standard 2-knob amp. Colours: grey, green, mustard, tangerine. Snip 59/–
PERDIO. Starmaker de luxe, size 16×15½×7×in. as above, but base, treble, vol., chrome trim 59/–
Two-tone blue, as above, but deeper, will take Garrard record player or BSR (please specify) 69/–

POST 1/– NOW FOR "FLOG LIST"
To TECHNICAL TRADING CO., Park Crescent Place, Brighton
Please send free "Flog List", without obligation, to

NAME.....
BLOCK CAPITALS PLEASE
ADDRESS.....
.....
.....P.E.1/70

TECHNICAL TRADING

★ LONDON 10 Tottenham Court Rd., W1 Tel MUSeum 2639
★ BRIGHTON 6 Queens Road Tel. 23975
★ PORTSMOUTH 350-342 Fratton Rd. Tel. 22034
★ SOUTHAMPTON 72 East Street Tel. 25851
★ MAIL ORDER

Devonian Court, Park Crescent Place, Brighton (Tel. 680722) 24 hour Telephone C.O.D. Order Recording Service
Widest range of audio equipment and electronic components in all branches at keenest prices
Complete installation quotations a speciality

POSTAGE: Add ½lb., 1/–; 1½lb., 2/6; 6 lb., 4/6; 10 lb., 6/–; 14lb., 7/6; 22lb., 10/6.

P. & P. 1/–

WENTWORTH RADIO

104 SALISBURY ROAD, HIGH BARNET
Tel. 01-449 3087

AF116	3/6	BC171	3/6	BSY27	4/–	NKT244	4/–	2N708	4/–
AF117	3/6	BC172	3/6	BSY28	4/–	NKT245	4/6	2N709	13/6
AF118	8/–	BCY32	5/6	BSY29	4/–	NKT261	5/–	2N718	5/–
AF124	5/–	BCY33	6/–	GET113	4/–	NKT262	5/–	2N726	5/–
AF125	5/–	BFY10	4/6	GET114	4/6	NKT264	5/6	2N727	5/–
AF126	5/–	BFY11	4/6	GET116	6/6	NKT275	4/6	2N743	5/–
AF127	5/–	BFY12	5/–	GET118	4/–	NKT674F	5/6	2N744	5/–
ASY26	6/–	BFY13	5/6	GET119	4/6	NKT713	6/6	2N753	5/–
ASY27	7/6	BFY17	5/–	NKT0013	5/–	NKT717	9/–	2N1303	4/6
ASY28	6/–	BFY18	4/6	NKT124	8/9	NKT773	5/3	2N1304	5/–
ASY54	6/–	BFY19	5/–	NKT125	5/9	NKT781	6/6	2N1305	5/–
ASY62	5/6	BFY29	7/6	NKT126	6/6	NKT10339	6/6	2N1306	5/6
BC107	3/–	BFY30	7/6	NKT128	5/3	2N696	5/–	2N1307	5/–
BC108	3/–	BSY24	4/–	NKT135	5/3	2N697	4/–	2N1308	6/6
BC109	3/6	BSY25	4/–	NKT137	6/6	2N706	2/6	2N1309	5/6
BC170	3/6	BSY26	4/–	NKT210	5/9	2N706A	3/–	2N1711	6/–

Revised Price Lists now available—Send S.A.E.

ORGAN BUILDERS!

Use our bistable dividers for your tone sources and cut your costs by more than half.

A small printed board with four complete transistor dividers will cost you only 18/6 including postage so why pay more?

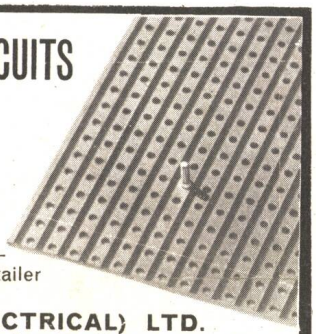
Removed from working equipment, each circuit is meticulously inspected and tested before dispatch.

Please look for our future advertisements which will appear in the Classified Section while stocks last.

Just send a S.A.E. for free details to:

Roger Allen
13 Millways, Great Totham, Essex

BUILD YOUR CIRCUITS on VEROBOARD

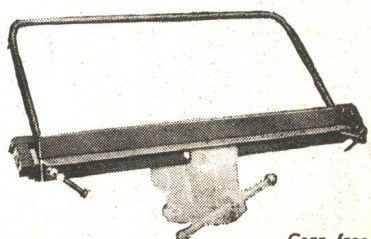


—the Universal Wiring Board—
obtainable from your local Retailer

Trade enquiries to:
NORMAN ROSE (ELECTRICAL) LTD.
8 St. Chad's Place, Gray's Inn Road, London, W.C.1

Technical enquiries to:
VERO ELECTRONICS LTD.
Industrial Estate, Chandler's Ford, Hants

PARKERS SHEET METAL FOLDING MACHINES HEAVY VICE MODELS



With Bevelled Former Bars

		Carr. free
No. 1.	Capacity 18 gauge mild steel × 36in. wide	£14.0.0
No. 2.	Capacity 18 gauge mild steel × 24in. wide	£8.0.0
No. 3.	Capacity 16 gauge mild steel × 18in. wide	£8.0.0

Also new bench models. Capacities 48in. × 18 gauge £40. 36in. × 18 gauge £27.10.0. 24in. × 16 gauge £26.10.0. Carriage free.
End folding attachments for radio chassis. Tray and Box making for 36in. model, 5/6 per ft. Other models 3/6. The two smaller models will form flanges. As supplied to Government Departments, Universities, Hospitals.
One year's guarantee. Money refunded if not satisfied. Send for details.

A. B. PARKER, Folding Machine Works, Upper George St., Heckmondwike, Yorks. Heckmondwike 3997

SEMICONDUCTORS & COMPONENTS

BRAND NEW (Saturday callers only 5% Discount) **GUARANTEED**

TRANSISTORS

2G301	4/-	2N3053	6/6	2S005	15/-	BC113	6/6	BFY75	6/-	NKT240	6/-
2G302	4/-	2N3054	11/6	2S020	37/6	BC115	6/6	BFY76	6/-	NKT241	6/6
2G303	4/-	2N3055	15/-	2S102	6/6	BC116	12/6	BFY77	11/6	NKT10419	6/-
2G306	8/6	2N3133	6/-	2S103	6/6	BC118	6/6	BFY90	12/6	NKT10439	6/-
2G308	6/-	2N3134	6/-	2S104	6/6	BC121	4/-	BFW58	7/6	NKT10519	6/-
2G309	6/-	2N3135	6/-	2S501	5/6	BC122	4/-	BFW59	6/6	NKT80111	15/6
2G371	3/-	2N3136	6/-	2S502	5/6	BC125	13/6	BFW60	6/6	NKT80112	19/6
2G374	5/6	2N3390	10/6	2S503	5/6	BC126	13/6	BSX19	5/6	NKT20329	8/6
2G381	4/6	2N3391	7/6	3N83	37/6	BC140	11/-	BSX20	5/6	NKT20339	10/6
2N404	6/6	2N3391A	6/-	3N128	18/6	BC147	5/-	BSX21	8/6	NKT80113	22/6
2N696	5/-	2N3392	6/6	3NI40	19/6	BC148	4/6	BSX26	10/6	NKT80211	18/6
2N697	5/-	2N3393	6/6	3NI41	21/6	BC149	5/-	BSX27	10/6	NKT80212	18/6
2N698	4/6	2N3394	5/6	3NI42	16/6	BC157	4/-	BSX28	6/-	NKT80213	18/6
2N706	2/6	2N3402	7/6	3NI43	19/6	BC158	3/6	BSX60	19/6	NKT80214	18/6
2N706A	2/6	2N3403	7/6	3N152	24/-	BC159	4/-	BSX61	12/6	NKT80215	18/6
2N708	4/-	2N3404	8/6	R.C.A.:—		BC160	12/6	BSX76	4/6	NKT80216	18/6
2N709	12/6	2N3405	12/6	40250	16/6	BC167	3/6	BSX77	6/6	OC20	21/6
2N718	6/-	2N3414	5/6	40251	17/6	BC168	3/6	BSX78	6/6	OC22	8—
2N726	5/-	2N3415	6/6	40253	8/6	BC169	3/6	BSY10	5/6	OC23	8/-
2N727	5/-	2N3416	7/6	40254	10/6	BC170	3/6	BSY11	5/6	OC24	7/6
2N743	4/6	2N3417	11/6	40309	10/6	BC171	3/6	BSY24	4/-	OC25	8/-
2N744	4/6	2N3570	12/6	40310	13/-	BC172	3/6	BSY25	4/-	OC26	6/6
2N753	5/6	2N3572	12/6	40311	10/6	BC182	4/6	BSY26	4/-	OC28	8/6
2N914	3/6	2N3605	5/6	40312	13/6	BC183	4/6	BSY27	4/-	OC30	8/-
2N916	3/6	2N3606	5/6	40314	11/-	BC184	4/6	BSY28	4/-	OC35	6/6
2N918	6/-	2N3607	4/6	40315	11/-	BC212L	5/-	BSY29	4/-	OC36	6/6
2N929	5/6	2N3662	9/6	40316	12/6	BCY10	5/6	BSY32	5/-	OC38	10/6
2N930	6/6	2N3663	10/-	40317	11/-	BCY12	5/6	BSY36	5/-	OC41	4/6
2N987	10/6	2N3702	4/-	40319	14/-	BCY30	7/6	BSY37	5/-	OC42	4/-
2N1090	6/6	2N3703	4/6	40320	11/-	BCY31	4/6	BSY38	4/6	OC44	4/-
2N1091	6/6	2N3704	5/6	40323	10/6	BCY32	7/6	BSY39	4/6	OC45	2/6
2N1131	8/6	2N3705	4/6	40324	12/6	BCY33	5/6	BSY40	6/6	OC46	3/-
2N1132	8/6	2N3706	4/6	40326	10/6	BCY34	5/6	BSY51	10/6	OC71	2/6
2N1302	4/-	2N3707	4/-	40329	7/6	BCY38	5/6	BSY52	6/-	OC72	2/6
2N1303	4/-	2N3708	4/-	40344	8/-	BCY39	6/6	BSY53	9/-	OC75	4/6
2N1304	4/6	2N3709	4/-	40347	10/-	BCY40	7/6	BSY54	6/-	OC76	3/-
2N1305	4/6	2N3710	4/-	40348	11/-	BCY42	3/-	BSY56	6/-	OC77	4/-
2N1306	5/-	2N3711	4/-	40360	12/6	BCY43	3/-	BSY78	9/6	OC78D	3/-
2N1307	5/-	2N3819	9/-	40361	12/6	BCY54	7/6	BSY79	9/6	OC81	4/-
2N1308	6/-	2N3820	21/6	40362	14/6	BCY58	4/6	BSY82	10/6	OC81D	3/-
2N1309	6/-	2N3823	17/6	40370	8/6	BCY59	4/6	BSY83	11/6	OC82	3/-
2N1420	7/6	2N3854	5/6	40467	16/6	BCY60	19/6	BSY84	12/6	OC82D	3/-
2N1507	5/6	2N3854A	5/6	40468A	16/6	BCY70	5/6	BSY85	13/6	OC83	4/6
2N1525	7/6	2N3855	5/6	AC107	6/-	BCY71	9/6	BSY87	10/6	OC84	5/-
2N1526	7/6	2N3855A	6/-	AC126	4/-	BCY72	5/-	BSY90	11/6	OC123	4/6
2N1527	7/6	2N3856	6/-	AC127	5/-	BCZ10	4/6	BSY95A	3/6	OC139	6/6
2N1605	9/6	2N3856A	6/-	AC128	4/-	BCZ11	4/6	BSW41	8/6	OC140	6/6
2N1613	6/6	2N3858	5/-	AC154	4/6	BD121	19/6	BSW70	5/6	OC170	6/-
2N1631	8/6	2N3858A	6/-	AC176	6/-	BD123	23/6	D16P1	7/6	OC171	6/-
2N1632	8/6	2N3859	5/6	AC187	12/-	BD124	12/-	D16P2	8/-	OC200	5/6
2N1637	8/6	2N3859A	6/6	AC188	12/-	BFI15	5/6	D16P3	7/6	OC201	5/6
2N1638	8/6	2N3860	6/-	ACY17	5/-	BFI17	10/6	D16P4	8/-	OC202	8/6
2N1639	8/6	2N3877	9/-	ACY18	5/-	BFI67	6/6	GET102	6/-	OC203	5/6
2N1711	6/6	2N3877A	9/6	ACY19	5/-	BFI73	7/6	GET113	4/-	OC204	5/6
2N1889	8/-	2N3900	10/6	ACY20	5/-	BFI77	11/6	GET114	4/-	OC205	7/6
2N1893	8/6	2N3900A	11/6	ACY21	5/-	BFI78	10/6	GET116	6/-	OC207	7/6
2N2147	17/6	2N3901	19/6	ACY22	4/-	BFI79	11/6	GET118	4/-	OCP71	10/6
2N2148	12/6	2N3903	8/-	ACY28	4/-	BFI80	7/6	GET119	4/-	ORP12	8/6
2N2160	14/6	2N3904	8/6	ACY40	4/-	BFI81	6/6	GET120	6/6	ORP60	10/-
2N2193	5/6	2N3905	8/-	ACY41	5/-	BFI84	7/6	GET873	3/-	ORP61	10/-
2N2193a	5/6	2N3906	8/6	ACY44	8/-	BFI85	5/6	GET880	6/-	P346A	5/6
2N2194A	4/6	2N4058	6/6	AD140	8/-	BFI94	6/6	GET887	4/-	TIP31A	19/6
2N2217	6/-	2N4059	5/-	AD149	8/-	BFI95	5/6	GET889	4/6	TIP32A	22/6
2N2218	6/-	2N4060	5/-	AD150	15/6	BFI96	5/6	GET890	4/6	TIS34	17/6
2N2219	6/-	2N4061	5/-	AD161	7/6	BFI97	5/6	GET896	4/6	TIS43	8/6
2N2220	5/-	2N4062	5/6	AD162	7/6	BFI98	5/6	GET897	4/6	TIS44	3/-
2N2221	5/-	2N4244	9/6	AF106	11/6	BF200	10/6	GET898	4/6	TIS45	4/-
2N2222	5/-	2N4255	8/6	AF114	5/-	BF224	6/6	MAT100	6/-	TIS46	4/-
2N2287	21/6	2N4255	7/6	AF115	5/-	BF225	6/6	MAT101	6/-	TIS47	4/-
2N2297	6/-	2N4285	3/6	AF116	5/-	BF237	6/6	MAT120	6/-	TIS48	4/-
2N2303	7/6	2N4286	3/6	AF117	5/-	BF238	6/6	MAT121	6/-	TIS49	4/-
2N2368	6/6	2N4287	3/6	AF118	12/6	BFX12	5/6	MJ400	21/6	TIS50	5/6
2N2369	7/6	2N4288	3/6	AF119	4/-	BFX13	5/6	MJ420	22/6	TIS51	4/-
2N2369A	5/-	2N4289	4/6	AF124	5/-	BFX29	12/6	MJ421	22/6	TIS52	4/-
2N2410	10/6	2N4290	3/6	AF125	5/-	BFX30	9/-	MJ430	20/6	TIS53	6/-
2N2411	6/6	2N4291	3/6	AF126	5/-	BFX43	8/6	MJ440	19/-	TIS60	6/6
2N2412	6/6	2N4292	3/6	AF127	5/-	BFX44	8/6	MJ480	20/6	TIS61	6/6
2N2483	5/6	2N4433	5/6	AF139	7/6	BFX68	13/6	MJ481	27/6	TIS87	3/6
2N2484	5/6	2N4434	5/6	AF178	12/6	BFX68A	13/6	MJ490	22/6	TIS88	3/6
2N2539	4/6	2N4435	5/6	AF179	11/6	BFX84	8/-	MJ491	29/6	TIS90	3/6
2N2540	4/6	2N5027	10/6	AF180	12/6	BFX85	10/-	MPF102	8/6	ZTX107	3/6
2N2613	7/9	2N5028	11/6	AF181	8/6	BFX86	8/-	MPF103	7/6	ZTX108	3/6
2N2614	7/6	2N5029	9/6	AF239	7/6	BFX87	10/-	MPF104	7/6	ZTX109	3/6
2N2645	6/-	2N5030	8/6	AF279	13/6	BFX88	5/-	MPF105	8/-	ZTX300	4/-
2N2646	11/6	2N5172	4/6	AF280	13/6	BFX89	12/6	MPS3638	6/6	ZTX301	4/-
2N2696	6/6	2N5174	12/6	AFZ11	5/6	BFX92A	12/6	NKT0013	8/6	ZTX302	5/-
2N2711	8/6	2N5175	12/6	AFZ12	6/6	BFY10	4/6	NKT124	8/6	ZTX303	5/-
2N2712	8/6	2N5176	13/6	ASY26	5/6	BFY11	4/6	NKT125	6/-	ZTX304	7/6
2N2713	9/-	2N5232	8/6	ASY27	8/6	BFY17	4/6	NKT126	7/6	ZTX500	5/-
2N2714	9/-	2N5232A	9/-	ASY28	5/6	BFY18	4/6	NKT128	5/6	ZTX501	5/-
2N2865	12/6	2N5245	12/6	ASY29	4/6	BFY19	4/6	NKT135	5/6	ZTX502	6/-
2N2904	8/-	2N5246	12/6	ASY36	5/-	BFY20	12/6	NKT137	6/6	ZTX503	5/-
2N2904A	8/-	2N5249	13/6	ASY50	5/-	BFY21	8/6	NKT210	6/-	ZTX504	12/6
2N2905	8/-	2N5249A	13/6	ASY51	6/6	BFY24	9/-	NKT211	6/6		
2N2905A	8/-	2N5305	7/6	ASY53	5/-	BFY25	5/-	NKT212	5/6		
2N2906	8/-	2N5306	8/-	ASY54	5/-	BFY26	4/-	NKT213	6/6		
2N2906A	8/-	2N5307	7/6	ASY62	5/-	BFY29	10/-	NKT214	4/6		
2N2907	8/-	2N5308	7/6	ASY63	3/6	BFY30	10/-	NKT215	4/6		
2N2923	4/-	2N5309	12/6	ASY72	5/-	BFY36	4/-	NKT216	6/6		
2N2924	4/6	2N5310	8/6	ASY83	5/-	BFY37	5/-	NKT217	8/6		
2N2925	4/6	2N5354	5/6	ASY86	6/6	BFY41	10/-	NKT219	6/6		
2N2926		2N5355	5/6	ASZ20	7/6	BFY43	13/6	NKT223	6/6		
„ Green	3/-	2N5356	10/6	ASZ21	7/6	BFY50	4/6	NKT224	5/-		
„ Yellow	2/9	2N5365	9/6	AUY10	30/-	BFY51	4/6	NKT225	5/-		
„ Orange	2/6	2N5366	10/-	BC107	3/6	BFY52	4/6	NKT229	6/-		
2N3011	5/-	2N5367	11/6	BC108	3/6	BFY53	5/6	NKT237	8/-		
2N3014	7/6	2N5457	7/6	BC109	3/6	BFY56A	11/-	NKT238	6/-		

Post & Packing 1/6d per order. Europe 5/-. Commonwealth (Air) 13/-.
Send 6d. stamp for price list.

PANEL METERS

38 Series—FACE SIZE 42 × 42mm. All prices for 1-9 pieces. 50μA, 37/6; 100μA, 35/-; 200μA, 32/6; 500μA, 27/6; 50-0-50μA, 35/-; 100-0-100μA, 32/6; 500-0-500μA, 25/-; 1MA, 25/-; 5MA, 25/-; 10MA, 25/-; 50MA, 25/-; 100MA, 25/-; 500MA, 25/-; 1A, 25/-; 5A, 25/-; 10V, 25/-; 20V, 25/-; 50V, 25/-; 300V, 25/-; 500V, 25/-

SILICON RECTIFIERS

PIV	50	100	200	400	600	800	1000	12000
1A	2/9	3/-	3/3	3/6	3/9	4/-	4/6	—
3A	3/-	—	—	4/6	—	6/-	—	—
6A	—	—	5/-	6/6	7/6	9/-	10/-*	—
10A	8/-	12/6	13/6	16/6	16/6	19/6	23/-	30/-
17A	—	15/6	16/9	21/-	21/-	26/-	32/6	43/6

*5A only 1A Types are plastic

DIODES & RECTIFIERS

IN461	1/6	IS130	2/6	BAX13	2/6	BYZ10	9/-	OA73	2/-
IN914	1/6	IS132	2/6	BAX16	2/6	BYZ11	7/6	OA79	1/9
IN916	1/6	IS131	3/-	BAY18	3/6	BYZ12	6/6	OA81	1/6
IN4007	4/6	AA119	2/-	BAY31	1/6	BYZ13	5/-	OA85	1/6
IS010	3/-	AAZ13	2/-	BAY38	2/6	FST3/4	4/6	OA90	1/6
IS021	4/-	AAZ15	2/6	BY100	4/6	FST3/8	6/-	OA91	1/6
IS025	5/-	AAZ17	2/6	BY103	4/6	OA5	2/6	OA95	1/6
IS113	3/-	BA100	2/-	BY122	7/6	OA9	2/-	OA182	2/-
IS120	2/6	BA102	4/-	BY124	3/-	OA47	1/6	OA200	2/-
IS121	2/6	BA115	1/6	BYX10	5/6	OA70	1/6	OA202	2/-

INTEGRATED CIRCUITS

RCA

CA3005	30/-	CA3020	30/-	CA3028A	25/-	CA3041	32/6
CA3011	20/-	CA3021	42/6	CA3028B		CA3042	32/6
CA3012	25/-	CA3022	35/-		35/-	CA3043	35/-
CA3013	30/-	CA3023	32/6	CA3035	35/-	CA3044	32/6
CA3014	30/-			CA3036	20/-	CA3045	32/6
CA3018	25/-			CA3039	25/-	CA3046	25/-
CA3019	25/-	CA3026	27/6			CA3048	55/-
						CA3051	25/-

Data and application sheets 2/- per type

Motorola

MC724P	Quad 2 Input Gates	19/6
MC789P	Hex Inverter	19/6
MC790P	Dual JK Flip Flop	32/6
MC799P	Dual Buffer	29/6

Fairchild

	1–6	6–11	12+
L900 Buffer	11/-	9/6	8/4
L914 Dual Gate	11/-	9/6	8/4
L923 JK Flip Flop	14/-	12/6	11/9
L709 Operational Amplifier	27/6	23/-	21/-

Quantity Prices on Application

General Electric

PA230	Low Level Amplifier	27/6
PA234	1 watt Audio Amplifier	26/6
PA237	2 watt Audio Amplifier	45/-

Mullard

FCH211	Hextuple DTL Inverter Gate	28/6
FCH221	Triple 3 Input DTL Line	28/6
FCJ101	3 Input JK Flip Flop	35/-
TAA241	Operational Amplifier	47/6
TAA243	Operational Amplifier	47/6
TAA263	Linear A.F. Amplifier	18/6
TAA320	Most L.F. Pre-Amplifier	15/6

Plessey

SL402A	Audio Amplifier	49/6
SL403A	Audio Amplifier	54/-

Data and application sheets 2/-

THYRISTORS

PIV	50	100	200	300	400
1A	5/-	5/6	7/6	8/-	9/6
3A	6/-	7/6	8/-	9/-	10/6
5A	—	8/-	9/-	—	12/6
7A	—	11/-	13/-	14/-	19/6
25A	27/6	30/-	33/-	—	37/6

Also 12A, 100 PIV, 15/-; 600 PIV, 35/6

VEROBOARD

	0·15 Matrix	0·1 Matrix
2½ × 3¾in	3/6	4/-
2½ × 5in	4/3	4/9
3¾ × 3¾in	4/3	4/9
3¾ × 5in	5/6	5/6
3¾ × 17in	16/-	21/6
3¾ × 17in (plain)	—	11/6
5 × 17in (plain)	15/6	—
Vero Pins (bag of 36)	3/-	3/-
Vero Cutter, 9/-		

HEAT SINKS

4·8 × 4 × 1in Finned for Two TO-3 Trans., 9/6. 4·8 × 2 × 1in Finned, for One TO-3 Trans., 6/6. For SO-1, 6d. For TO-5, 1/- Finned. For TO-18, 1/- Finned. For TO-18, 1/- Finned.

CAPACITORS

A large and comprehensive range available: Electrolytic, Polyester, Ceramic, Polystyrene, Silver Mica, Tantalum, Trimmers

Examples:
2,000mF 25V, 8/6
2,500mF 50V, 13/6
3,000mF 25V, 10/6
5,000mF 50V, 19/6

RESISTORS

Carbon Film
¼ watt 10%, 4d.
½ watt 5%, 5d.
1 watt 10%, 6d.
2 watt 10%, 1/-

WIRE-WOUND

2·5 watt 5% (up to 270 ohms only), 1/6
5 watt 5% (up to 8·2kΩ only, 2/-
10 watt 5% (up to 25kΩ only), 2/9

POTENTIOMETERS

Carbon:
Log. and Lin., less switch, 3/3.
Log. and Lin., with switch, 4/6.
Wire-wound Pots (3W), 6/6.
Twin Ganged Stereo Pots, Log. and Lin., 7/6.

PRESETS

Miniature and Sub-miniature (0·2W), Vertical and Horizontal, 1/6.

THERMISTORS

Large range in stock from 1·1 ohm to 150kΩ at 25°C.
We are happy to quote for quantity supplies to manufacturers, etc.

Telephone 01-452 0161/2/3

A MARSHALL & SON
28 CRICKLEWOOD BROADWAY, LONDON, N.W.2

CALLERS WELCOME
HRS. 9-5.30 Mon-Sat

Adamin

MODEL 15

MICRO SOLDERING INSTRUMENT

as selected for the DESIGN CENTRE LONDON

- **EXTREME VERSATILITY**
  Range of 8 interchangeable bits, from 3/64″ (.047″) to 3/16″, including new non-wearing PERMATIPS.
- **ULTRA-SMALL SIZE**
  Length 7⅛″. Weight ½ oz. Max. handle dia. 7/16″.
- **EXTRA-HIGH PERFORMANCE**
  Heating time 90 secs. Max. bit temp. 390°C. Loading 15 watts — equals normal 30/40 watt iron.
- **ALL VOLTAGES**

The ADAMIN range includes five other models (5, 8, 12, 18 and 24 watts), Thermal strippers (PVC and PTFE) and a De-Soldering Tool. Please ask for colour catalogue A/37.

LIGHT SOLDERING DEVELOPMENTS LTD.

28 Sydenham Rd., Croydon, CR9 2LL

Telephone 01-688 8589 & 4559

VALVES

SAME DAY SERVICE
NEW! TESTED! GUARANTEED!

SETS 1R5, 1S5, 1T4, 3S4, 3V4, DAF91, DF91, DK91, DL92, DL94. Set of 4 for 18/6. DAF96, DF96, DK96, DL96, 4 for 26/6

0Z4	4/6	12K8GT	7/3	DK91	5/9	EH90	6/3	PCL82	7/-	UBC41	9/-
1A7GT	7/6	12SN7GT	6/6	DK92	8/3	EL33	8/9	PCL83	9/-	UBF80	5/9
1H5GT	7/3	19BG6G	17/6	DK96	7/-	EL34	9/6	PCL84	7/6	UBF89	6/9
1N5GT	7/9	20F2	13/6	DL35	5/-	EL41	10/6	PCL85	9/-	UC92	5/-
1R5	5/9	20P3	11/9	DL92	5/9	EL84	4/9	PCL86	8/3	UCC84	7/-
1S5	4/3	20P4	18/6	DL94	6/-	EL90	4/6	PENA4	12/6	UCC85	6/9
1T4	2/9	25L6GT	5/-	DL96	7/-	EL500	12/6	PFL200	11/9	UCF80	7/3
3S4	5/9	25U4GT	11/6	DY86	5/9	EM80	7/6	PL36	9/9	UCH42	11/6
3V4	6/-	30C1	6/6	DY87	5/9	EM81	7/6	PL81	7/3	UCH81	6/3
5U4G	4/6	30C15	13/-	EABC80	6/6	EM84	6/6	PL82	6/6	UCL82	6/9
5Y3GT	5/9	30C17	16/-	EAF42	10/-	EM87	7/6	PL83	6/6	UCL83	11/6
5Z4G	7/6	30C18	11/6	EB91	2/3	EY51	7/6	PL84	6/6	UF41	10/6
6/30L2	12/-	30F5	16/-	EBC33	8/-	EY86	6/6	PL500	13/-	UF80	7/-
6AL5	2/3	30FL1	13/9	EBC41	9/6	EZ40	8/-	PL504	13/6	UF85	6/9
6AM6	2/9	30FL12	14/6	EBF80	6/9	EZ41	8/-	PL508	23/6	UF89	6/9
6AQ5	4/6	30FL14	12/-	EBF89	6/3	EZ80	4/6	PM84	7/6	UL41	10/9
6AT6	4/-	30L1	6/6	ECC81	3/9	EZ81	4/9	PX25	10/6	UL44	20/-
6AU6	4/6	30L15	14/-	ECC82	4/9	GZ32	8/9	PY32	10/-	UL84	7/-
6BA6	4/6	30L17	15/6	ECC83	7/-	GZ34	9/9	PY33	10/-	UM84	6/6
6BE6	4/9	30P4	12/-	ECC85	5/-	KT61	8/9	PY81	5/3	UY41	7/6
6BJ6	8/6	30P12	13/9	ECC91	3/-	KT66	16/-	PY82	5/3	UY85	5/9
6BW6	13/-	30P19	12/-	ECC804	12/-	N78	17/6	PY83	5/9	VP4B	10/-
6F13	3/6	30PL1	13/9	ECF80	6/6	PABC80	7/-	PY88	6/9	W119	7/-
6F14	9/-	30PL13	15/6	ECF82	5/9	PC86	10/3	PY800	7/6	Z77	2/9
6F23	14/3	30PL14	15/6	ECH35	6/-	PC88	10/3	PY801	6/9	AC107	3/6
6F25	13/-	35L6GT	8/6	ECH42	12/6	PC96	8/6	R19	6/6	AC127	2/6
6J6	3/-	35W4	4/6	ECH81	5/3	PC97	8/6	R20	12/6	AD140	7/6
6K7G	2/6	35Z4GT	5/-	ECH84	7/6	PC900	7/6	U25	13/-	AF115	3/-
6K8G	2/9	6063	12/6	ECL80	6/9	PCC84	6/6	U26	12/-	AF116	3/-
6L18	6/-	AC/VP2	10/-	ECL82	6/9	PCC85	6/-	U47	13/6	AF117	3/3
6V6G	3/3	AZ31	9/6	ECL83	8/6	PCC88	9/-	U49	13/6	AF125	3/6
6V6GT	6/6	B729	12/6	ECL86	8/-	PCC89	10/6	U52	4/6	AF127	3/6
6X4	4/3	CCH35	13/6	EF37A	6/6	PCC189	11/6	U78	4/3	OC26	5/9
6X5GT	5/9	CL33	18/6	EF39	4/9	PCF80	6/6	U191	12/6	OC44	2/3
7B7	7/-	CY31	6/9	EF41	10/9	PCF82	6/6	U193	8/6	OC45	2/3
7C6	6/9	DAC32	7/3	EF80	4/6	PCF86	11/6	U251	14/6	OC71	2/6
10F1	14/-	DAF91	4/3	EF85	5/3	PCF200	13/6	U301	10/6	OC72	2/6
10F18	7/-	DAF96	6/6	EF86	6/3	PCF800	13/6	U329	14/6	OC75	2/6
10P13	15/6	DF33	7/9	EF89	5/3	PCF801	6/9	U801	19/6	OC81	2/3
12AT7	3/9	DF91	2/9	EF91	2/9	PCF802	9/-	UABC80	6/6	OC81D	2/3
12AU6	4/9	DF96	6/6	EF94	4/6	PCF805	11/6	UAF42	10/3	OC82	2/3
12AU7	4/9	DH77	4/-	EF183	5/9	PCF808	12/-	UB41	6/6	OC82D	2/6
12AX7	4/9	DK32	7/6	EF184	5/6	PCL81	8/9			OC170	2/6

READERS RADIO (P.E.)

85 TORQUAY GARDENS, REDBRIDGE, ILFORD, ESSEX. **Tel. 01-550 7441**

Postage on 1 valve 9d. extra. On 2 valves or more, postage 6d. per valve extra. Any Parcel Insured against Damage in Transit 6d. extra.

SAVE TIME-MAKE MONEY

with Practical Electrical Engineering

This complete library of electrical know-how and practice will give you the knowledge which normally takes a lifetime to acquire. It will help you to understand the many branches of the electrical industry from installation, equipment, instruments, motors and machines, repair, maintenance and operation right through to the generation and distribution of electricity. **2,350 pages—over 2,000 photos and drawings.** Examine this valuable set in your home. Post coupon now — there's no obligation to buy.

Sent by post on 10 days FREE TRIAL

To: Buckingham Press Ltd., P.O. Box 14, Gatehouse Road, Aylesbury, Bucks.

Please send *Practical Electrical Engineering* without obligation to buy. I will return the books in 8 days or post—

Tick here (✓) ☐ Full cash price of £16, or ☐ 16/- dep. and 16 monthly payments of 20/-, paying £16.16.0.

If you are under 21 your father must fill up coupon.

Full Name .....
(BLOCK LETTERS)
Address .....
..... County .....
Occupation .....
Signature PEE/5082

Mr. / Mrs. / Miss

Please tick (✓) here

The address on left is
My/our property ☐
Rented unfurnished ☐
Furnished accom ☐
Temporary address ☐

ELECTROVALUE

Everything brand new and to specification • Large stocks • Good service

RESISTORS

Code	Power	Tolerance	Range	Values available	1 to 9	10 to 99	100 up
C	$\frac{1}{20}$W	5%	100Ω–220kΩ	E12	16d	11d	13d
C	$\frac{1}{8}$W	5%	4·7Ω–1MΩ	E24	2·5d	2d	1·75d
C	$\frac{1}{4}$W	10%	4·7Ω–10MΩ	E12	2·5d	1·75d	1·5d
C	$\frac{1}{4}$W	5%	4·7Ω–10MΩ	E24	3d	2·25d	2d
MO	$\frac{1}{2}$W	2%	18Ω–1MΩ	E24	9d	8d	7d
C	1W	10%	4·7Ω–10MΩ	E12	4d	3·25d	3d
WW	1W	10% $\pm\frac{1}{20}\Omega$	0·22Ω–3·3Ω	E12	15d all quantities		
WW	3W	5%	12Ω–10kΩ	E12	15d all quantities		
WW	7W	5%	12Ω–10kΩ	E12	15d all quantities		

CODES: C = carbon film, high stability, low noise. MO = metal oxide, Electrosil TR5, ultra low noise. WW = wire wound, Plessey.
VALUES: E12 denotes series: 1, 1·2, 1·5, 1·8, 2·2, 2·7, 3·3, 3·9, 4·7, 5·6, 6·8, 8·2 and their decades. E24 denotes series: as E12 plus 1·1, 1·3, 1·6, 2, 2·4, 3, 3·6, 4·3, 5·1, 6·2, 7·5, 9·1 and their decades.
Prices are in pence each for each ohmic value and power rating. (Ignore fractions of one penny on total resistor order.)

COLVERN 3 watt wire-wound potentiometers: 10Ω, 15Ω, 25Ω, 50Ω, 100Ω, 150Ω, 250Ω, 500Ω, 1kΩ, 1·5kΩ, 2·5kΩ, 5kΩ, 10kΩ, 15kΩ, 25kΩ, 50kΩ. Price only **5/6** each.

CARBON TRACK POTENTIOMETERS: Double wiper ensures minimum noise level. Long plastic spindles.

	each
Single gang linear: 220Ω, 470Ω, 1kΩ, etc. to 2·2MΩ	2/6
Single gang log: 4kΩ, 10kΩ, 22kΩ, etc. to 2·2MΩ	2/6
Any type with ½ amp double pole mains switch: extra	2/3
Dual gang linear: 4kΩ, 10kΩ, 22kΩ, etc. to 1MΩ	8/6
Dual gang log: 4kΩ, 10kΩ, 22kΩ, etc. to 2M2Ω	8/6
Log/Anti-log: 10kΩ, 47kΩ, 1MΩ only	8/6
Dual anti-log: 10kΩ only	8/6

FETS n-channel. Low cost general purpose 2N5163, 25V, only **5/–** each. Audio/r.f., Texas 2N3819 **9/–**, Motorola 2N5459 (MPF105) **9/6** each.

NEW PLESSEY INTEGRATED CIRCUIT POWER AMPLIFIER, Type SL403A. Only **57/–** each. Operates with 18V power supply. Sensitivity 20MV into 20MΩ, 3W into 7·5Ω. P.E., Nov. 69, Stereo Amplifier kit less metalwork **£11.18.2** net complete.

70 WATT BAILEY AMPLIFIER COMPONENTS
Transistors for one channel **£7.9.6.** list, with 10% discount only **£6.14.6.** Transistors for two channels **£14.19.** list, with 15% discount only **£12.14.** Capacitors and/resistors for one channel list **£2.** Printed circuit board free with each transistor set. Complete unregulated power supply kit **£4.14.6.** mono or stereo, subject to discount. Complete regulated power supply kit **£9.5.** subject to discount. Further details on application.

SINCLAIR IC10 Integrated Circuit Amplifier and Pre-amplifier. This remarkable monolithic integrated circuit amplifier and pre-amp is now available from stock. The equivalent of 13 transistor/18 resistor circuit plus 3 diodes and the first of its kind ever. It is d.c. coupled and applicable to an unusually wide range of uses as detailed in the manual provided with it. As advertised, post free **59/6** net.

CARBON SKELETON PRE-SETS. Small high quality, type PR: Linear only, 100Ω, 220Ω, 470Ω, 1kΩ, 2kΩ, 4kΩ, 10kΩ, 22kΩ, 47kΩ, 100kΩ, 220kΩ, 470kΩ, 1MΩ, 2MΩ, 5MΩ, 10MΩ vertical or horizontal mounting, **1/–** each.

S-DeC's put an end to "birdsnesting". Components just plug in. Saves valuable time. Use components again and again. S-DeC only **30/6** post free. Compact T-DeC, increased capacity, may be temperature-cycled. T-DeC only **51/–** post free.

LARGE CAPACITORS. All new stock. High ripple current types: 2,000μF 25V **7/4**; 2,000μF 50V **11/4**; 5,000μF 25V **12/6**; 5,000μF 50V **21/11**; 1,000μF 100V **16/3**; 2,000μF 100V **28/9**; 5,000μF 70V **36/–**; 5,000μF 100V **58/3**; 1,000μF 50V **8/2**; 2,500μF 64V **15/5**; 2,500μF 70V **19/6**.

MEDIUM ELECTROLYTICS. Axial leads: Values (μF/V): 50/50 **1/9**; 100/25 **1/9**; 100/50 **2/6**; 250/25 **2/6**; 250/50 **3/9**; 500/25 **3/9**; 1,000/10 **3/–**; 500/50 **4/6**; 1,000/25 **4/6**; 1,000/50 **7/–**; 2,000/25 **6/–**. Small electrolytics, axial leads: 5/10, 10/10, 25/10, 50/10, **1/–** each; 25/25, 47/25, 100/10, 220/10, **1/3** each.

PEAK SOUND ENGLEFIELD KITS

Build it 12 + 12 or 25 + 25. Brilliant new styling and available in two forms: **STEREO 15 WATTS PER CHANNEL.** In kit form with complete amplifier and pre-amplifier modules and power supply. Output per channel into 15Ω —12W R.M.S. Price **£38.4.0.** net. **STEREO 25 WATTS PER CHANNEL.** As above but output per channel into 15Ω —25W R.M.S. Price **£53.15.0.** net. Brief specification: Total harmonic distortion 0·1%.
Inputs: Magnetic, Ceramic, Tape, Radio, Signal to noise ratios: Better than 60dB all inputs.
O/Load factor 28dB all channels.
ENGLEFIELD CABINET to house either above assemblies (as illustrated) **£5.0.0.** net. *Other peak sound products as advertised.*

MULLARD SUB-MIN ELECTROLYTICS C426 RANGE. Price **1/3** each. Axial leads, Values (μF/V): 0·64/64; 1/40; 1·6/25; 2·5/16; 2·5/64; 4/10; 4/40; 5/64; 6·4/6·4; 6·4/25; 8/4; 8/40; 10/2·5; 10/16; 10/64; 12·5/25; 16/40; 20/16; 20/64; 25/6·4; 25/25; 32/4; 32/10; 32/40; 32/64; 40/16; 40/2·5; 50/6·4; 50/25; 50/40; 64/4; 64/10; 80/2·5; 80/16; 80/25; 100/6·4; 125/4; 125/10; 125/16; 160/2·5; 200/6·4; 200/10; 250/4; 320/2·5; 320/6·4; 400/4; 500/2·5.

WAVECHANGE SWITCHES: 1P 12W; 2P 6W; 3P 4W; 4P 3W long spindles, **4/9** each. Slider switches, double pole double throw, **3/–** each.

BARGAINS IN NEW TRANSISTORS

All power types supplied with free insulating sets

2N696	5/6	2N5192	25/–
2N697	6/–	2N5195	29/3
2N706	3/–	40406	16/3
2N1132	14/3	40408	14/6
2N1302	4/–	AC126	6/6
2N1303	4/–	AC127	6/–
2N1304	4/6	AC128	6/–
2N1305	4/6	ACI76	11/–
2N1306	6/9	ACY22	3/9
2N1307	6/9	ACY40	4/–
2N1308	8/9	ADI40	19/–
2N1309	8/9	ADI49	17/6
2N1613	6/6	ADI61 }	16/–pr.
2N1711	7/4	ADI62 }	
2N2218	10/6	AFI18	16/6
2N2147	18/9	AFI24	7/6
2N2369A	6/9	AFI27	7/–
2N2646	10/9	BAI02	9/–
2N2924	4/3	BCI07	3/6
2N2925	5/3	BCI08	3/–
2N2926R	2/6	BCI09	3/6
2N2926O	2/6	BCI47	4/3
2N2926Y	2/3	BCI48	3/3
2N2926G	2/6	BCI49	4/3
2N3053	5/6	BCI53	10/–
2N3054	14/3	BCI54	11/–
2N3055	16/6	BCI57	3/9
2N3391A	5/6	BCI58	3/6
2N3702	3/6	BCI59	3/9
2N3703	3/3	BCI67	2/6
2N3704	3/9	BCI68	2/3
2N3705	3/5	BCI69	2/6
2N3706	3/3	BCI77	6/3
2N3703	4/–	BCI78	5/6
2N3708	2/9	BCI79	6/–
2N3709	3/–	BDI21	18/–
2N3710	3/3	BDI23	24/3
2N3711	3/11	BFI78	10/6
2N3904	7/6	BFX29	10/9
2N39085	7/6	BFX85	8/3
2N3731	23/–	BFX88	7/9
2N3820	25/6	BFY50	4/6
2N3323	10/6	BFY51	4/3
2N3794	3/3	BSX20	3/9
2N4286	3/3	MJ480	21/–
2N4289	3/3	MJ481	27/–
2N4291	3/3	MJ491	30/–
2N4292	3/3	P346A	5/9
2N4410	4/9	V405A	7/9

MAIN LINE AMPLIFIER KITS, as advertised. Prices net. Authorised dealer.

COMPONENT DISCOUNTS
10% on orders for components for £5 or more. 15% on orders for components for £15 or more (No discount on net items).

POSTAGE AND PACKING
Free on orders over **£1.** Please add 1/– if order is under £1. Overseas orders welcome: carriage charged at cost.

ELECTROVALUE **Dept. 28 ST. JUDES ROAD, ENGLEFIELD GREEN, EGHAM, SURREY**
Opening Hours: 9—5.30; Sat. 9 a.m. to 1 p.m. Tel.: Egham 5533 (STD 0784-3)

prepare now for tomorrow's world

Today there is a huge demand for technologists such as electronics, nuclear and computer systems engineers, radio and television engineers, etc. In the future, there will be even more such important positions requiring just the up-to-date, advanced technical education which CREI, the Home Study Division of McGraw-Hill Book Co., can provide.

CREI Study Programmes are directly related to the problems of industry including the latest technological developments and advanced ideas. The individual tuition given by the CREI panel of experts in each specialised field is comparable in technological content with that of technical colleges.

Take the first step to a better job now—enrol with CREI, the specialists in Technical Home Study Education.

CREI Programmes are available in:
Electronic Engineering Technology * Industrial Electronics for Automation * Computer Systems Technology * Nuclear Engineering * Mathematics for Electronics Engineers * Television Engineering * Radar and Servo Engineering * City and Guilds of London Institute: Subject No. 49 and Advanced Studies No. 300.

CREI

CREI (London), Walpole House, 173-176 Sloane Street, London S.W.1.
A Subsidiary of McGraw-Hill Inc.

Post this coupon today for a better future

To C.R.E.I. (London), Walpole House, 173-176 Sloane Street, London S.W.1.
Please send me (without obligation) details of your Educational Programmes

please tick
My interest is City and Guilds ☐ General ☐

Name .....
Address .....
.....
Electronics experience .....
..... PE 21

VARI-STAT
THERMOSTATIC
SOLDERING IRON

HIGH PRODUCTION MINIATURE MODEL D. 50 WATT

Weight	2 oz.
Heating time	50 seconds
Bit Sizes	1/16", 3/32", 1/8", 3/16", 1/4"
Nickel or Iron	Plated
Voltage	250 to 12 volts
Price	66/-

HIGH PRODUCTION INSTRUMENT MODEL H. 150 WATT

Weight	6 oz.
Heating time	1 min. 45 sec.
Bit Sizes	3/16", 1/4", 3/8", 7/16"
Nickel or Iron	Plated
Voltage	250 to 24 volts
Price	95/-

OTHER VARI-STAT IRONS:

Miniature Model M 50 watt Push-in Bits 1/32" 1/16", 3/32"
Instrument Model B 70 watt Bit Size 11/64"
Industrial Model I 500 watt Bit Size 5/8"

CARDROSS ENGINEERING CO. LTD.
Woodyard Road, Dumbarton
Phone: Dumbarton 2655

ERSIN Multicore 5 CORE SOLDER

for fast, easy, reliable soldering

Contains 5 cores of non-corrosive flux, instantly cleaning heavily oxidised surfaces. No extra flux required.

SAVBIT ALLOY ALSO REDUCES COPPER BIT WEAR.
Ecomically packed for general electrical and electronic soldering. 90 ft. 18 gauge on plastic reel. Recommended retail price **15/-**

THIN GAUGE SOLDER, ESSENTIAL FOR
soldering small components and thin wires. High tin content, low melting point, 60/40 alloy, 202 ft. 22 gauge on plastic reel. Recommended retail price **15/-**

A RANGE OF SOLDERS IN HANDY DISPENSERS.

REF.	ALLOY	SWG	
4A	60/40	18	2/6*
Size 5 (illustrated)	Savbit	18	2/6*
15	60/40	22	3/-*

*Recommended Price

INVALUABLE FOR STRIPPING FLEX, THE NEW AUTOMATIC OPENING BIB WIRE STRIPPER AND CUTTER, easily adjustable for all standard diameters. Plastic covered handles can also be used as wire cutter. Recommended retail price **8/6**

From Electrical and Hardware shops. If unobtainable, write to:
Multicore Solders Ltd., Hemel Hempstead, Herts.

BI-PRE-PAK LIMITED

FULLY TESTED AND MARKED

AC107	3/-	OC170	3/-
AC126	2/6	OC171	4/-
AC127	2/6	OC200	3/6
AC128	2/6	OC201	7/-
AC176	5/-	2G301	2/6
ACY17	3/-	2G303	2/6
AFI14	4/-	2N711	10/-
AFI15	3/6	2N1302-3	4/-
AFI16	3/6	2N1304-5	5/-
AFI17	3/6	2N1306-7	6/-
AF239	12/6	2N1308-9	8/-
AFI86	10/-	2N3844A	5/-
AFI39	10/-	**Power Transistors**	
BFY50	4/-	OC20	10/-
BSY25	7/6	OC23	10/-
BSY26	3/-	OC25	8/-
BSY27	3/-	OC26	5/-
BSY28	3/-	OC28	7/6
BSY29	3/-	OC35	5/-
BSY95A	3/-	OC36	7/6
OC41	2/6	AD149	10/-
OC44	2/6	AUY10	30/-
OC45	2/6	2N3055	15/-
OC71	2/6	**Diodes**	
OC72	2/6	AAY42	2/-
OC73	3/6	OA95	2/-
OC81	2/6	OA70	1/9
OC81D	2/6	OA79	1/9
OC83	4/-	OA81	1/9
OC139	2/6	IN914	1/6
OC140	3/6		

FREE!

PACKS OF YOUR OWN CHOICE UP TO THE VALUE OF 10/- WITH ORDERS OVER £4

TRY OUR X PAKS FOR UNEQUALLED VALUE

XA PAK

Germanium PNP type transistors, equivalents to a large part of the OC range, i.e. 44, 45, 71, 72, 81, etc.

PRICE £5 PER 1000

POST & PACKING 4/6 U.K.

XB PAK

Silicon TO-18 CAN type transistors NPN/PNP mixed lots with equivalents to OC200-1, 2N706a, BSY27/29, BSY95A.

PRICE £4.5.0 PER 500
PRICE £8 PER 1000

POST & PACKING 2/6 U.K.

XC PAK

Silicon diodes miniature glass types, finished black with polarity marked, equivalents to OA200, OA202, BAY31-39 and DK10, etc.

PRICE £4.10.0 PER 1000

POST & PACKING 2/6 U.K.

ALL THE ABOVE UNTESTED PACKS HAVE AN AVERAGE OF 75% OR MORE GOOD SEMICONDUCTORS. FREE PACKS SUSPENDED WITH THESE ORDERS. ORDERS MUST NOT BE LESS THAN THE MINIMUM AMOUNTS QUOTED PER PACK.

NEW TESTED AND GUARANTEED PAKS

B2	4	Photo Cells, Sun Batteries inc. Book of Instructions	10/-
B77	2	AD161–AD162 NPN/PNP Trans. Comp. Output. Pair	10/-
B79	4	IN4007 Sil. Rec. Diodes 1000 P.I.V. 1 amp. Miniature	10/-
B81	10	Reed Switches, mixed types large and small	10/-
B89	2	5SP5 Light Sensitive Cells. Light Res. 400 Ω Dark 1M Ω	10/-
B91	8	NKT163/164 PNP Germ. TO-5 equivalent to OC44, OC45	10/-
B92	4	NPN. Sil. Trans. AO6= BSX20, 2N2369 500 MHz, 360mW	10/-
B93	5	GET113 Trans. equiv. to ACY17–21 PNP Germ.	10/-
B94	6	NPN Sil. Planar Epitaxial Trans. CS4 similar to BSY38 or BC108	10/-
B96	5	2N3136 PNP Sil. Trans. TO-18, HFE 100–300 I.C. 600mA. 200 MHz	10/-
B98	10	XB112 and XB102 equiv. to AC126, AC156, OC81/2, OC71/2, NKT271, etc.	10/-
B99	200	Capacitors, Electrolytics paper, silver mica, etc. Post and packing, this Pak 2/6	10/-
H4	250	Mixed Resistors. Post and Packing 2/-	10/-

LOOK! TRANSISTORS ONLY 1/- EACH

TYPE A
PNP SILICON ALLOY TO-5 CAN
SPEC:—
ICER AT VCE=20v
1mA MAX.
HFE 15–100
THESE ARE OF THE 2S300 TYPE WHICH IS A DIRECT EQUIVALENT TO THE OC200/205 RANGE

TYPE B
PNP SILICON PLASTIC ENCAPSULATION
SPEC:—
ICER AT VCE=10v
1mA MAX
HFE 10–200
THESE ARE OF THE 2N3702/3 AND 2N4059/62 RANGE

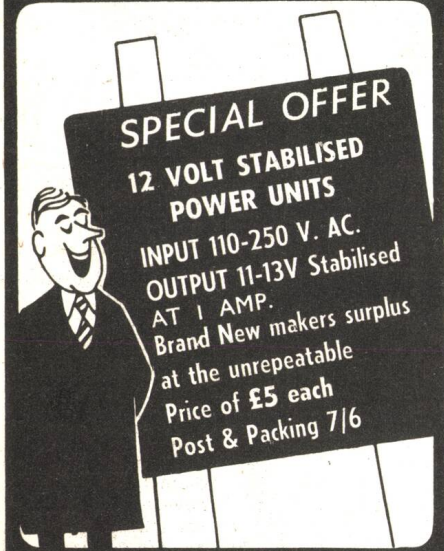
TYPE C
NPN SILICON TO-18 CAN
SPEC:—
ICER AT VCE=20v
1mA MAX
HFE 50–900
THESE ARE SIMILAR TO THE BC108/109 TYPES

RETURN OF THE UNBEATABLE P.I PAK. NOW GREATER VALUE THAN EVER

FULL OF SHORT LEAD SEMICONDUCTORS AND ELECTRONIC COMPONENTS, APPROX. 170. WE GUARANTEE AT LEAST 30 REALLY HIGH QUALITY FACTORY MARKED TRANSISTORS PNP AND NPN, AND A HOST OF DIODES AND RECTIFIERS MOUNTED ON PRINTED CIRCUIT PANELS. IDENTIFICATION CHART SUPPLIED TO GIVE SOME INFORMATION ON THE TRANSISTORS.

PLEASE ASK FOR PAK **P.I** ONLY **10/-**
2/- P. & P. on this Pak.

Make a Rev. Counter for your Car. The 'TACHO BLOCK'. This encapsulated block will turn any 0-1mA meter into a linear and accurate rev. counter for any car. **20/- each**


SPECIAL OFFER
12 VOLT STABILISED POWER UNITS
INPUT 110-250 V. AC.
OUTPUT 11-13V Stabilised AT 1 AMP.
Brand New makers surplus at the unrepeatable Price of £5 each
Post & Packing 7/6

NEW UNMARKED UNTESTED PAKS

B78	12	Intergrated Circuits, Data and Circuits of types, supplied with orders	10/-
B80	8	Dual Trans. Matched O/P pairs NPN. Sil. in TO-5 can	10/-
B82	10	OC45, OC81D and OC81 Trans. Mullard glass type	10/-
B83	200	Trans. manufacturer's rejects all types NPN, PNP, Sil. and Germ.	10/-
B84	100	Silicon Diodes DO-7 glass equiv. to OA200, OA202	10/-
B66	150	High quality Germ. Diodes. Min. glass type	10/-
B86	50	Sil. Diodes sub. min. IN914 and IN916 types	10/-
B87	100	Germ. PNP Trans. equiv. to OC44, OC45, OC81, etc.	10/-
B88	50	Sil. Trans. NPN, PNP, equiv. to OC200/1, 2N706A, BSY95A, etc.	10/-
B60	10	7 Watt Zener Diodes Mixed Voltages	10/-
H5	16	1 Amp. Plastic Diodes 50-1000 Volts	10/-
H6	40	250mW. Zener Diodes DO-7 Min. Glass Type	10/-

FREE CATALOGUE AND LISTS for:—

ZENER DIODES
TRANSISTORS, RECTIFIERS
FULL PRE-PAK LISTS
& SUBSTITUTION CHART

MINIMUM ORDER 10/- CASH WITH ORDER PLEASE. Add 1/- post and packing per order. OVERSEAS ADD EXTRA FOR AIRMAIL.

MULLARD DATA BOOK
Semiconductor and Valve Data and Equivalents.
Postage 6d.
3/6 EACH

FREE! A WRITTEN GUARANTEE WITH ALL OUR TESTED SEMICONDUCTORS

BI-PRE-PAK LTD DEPT. A, 222-224 WEST ROAD, WESTCLIFF-ON-SEA, ESSEX
TELEPHONE: SOUTHEND (0702) 46344

DUXFORD ELECTRONICS

ELECTROLYTIC CAPACITORS (Mullard). −10% to + 50%.

Working Voltage (V)—Capacitance (μF)							Price	Pack Prices		
4V	6·4V	10V	16V	25V	40V	64V	each	10 off	25 off	100 off
·8	6·4	4	2·5	1·6	1	0·64	1/4	12/4	26/6	89/6
32	25	16	10	6·4	4	2·5	1/2	10/6	23/–	80/3
64	50	32	20	12·5	8	5	1/2	10/4	22/6	77/9
125	100	64	40	25	16	10	1/–	8/9	18/9	63/6
250	200	125	80	50	32	20	1/1	9/6	20/9	70/9
400	320	200	125	80	50	32	1/2	10/4	22/6	77/9
800	640	400	250	160	100	64	1/6	13/4	29/6	102/9
1,250	1,000	640	400	250	160	100	2/–	18/10	37/9	134/4
2,000	1,600	1,000	640	400	250	160	2/6	22/3	44/3	165/6
3,200	2,500	1,600	1,000	640	400	250	3/–	26/9	59/–	204/3
				800	500	320	5/3	46/6	101/–	343/9
				1,250	800	500	6/6	57/6	125/4	427/–
				2,000	1,250	800	8/–	71/4	157/–	541/8
				4,000	2,500	1,600	12/6	91/6	194/9	343/9
				6,400	4,000	2,500	15/–	133/4	281/8	1,000/–

POLYESTER CAPACITORS (Mullard)

Tubular, 10%, 160V:
Prices per Capacitance value (μF)

	each	10 off	25 off	100 off
0·01, 0·015, 0·022	7d	5/1	10/11	36/5
0·033, 0·047	7d	5/8	11/10	37/6
0·068	8d	6/6	13/6	43/9
0·1	9d	6/8	14/3	47/7
0·15	11d	7/6	16/6	57/3
0·22	1/–	8/2	17/9	61/5
0·33	1/3	10/11	23/3	77/1
0·47	1/6	13/2	28/1	93/9
0·68	2/3	19/5	42/3	140/7
1·0	2/8	23/4	48/9	165/7

Tubular, 10%, 400V:
Prices per Capacitance value (μF)

	each	10 off	25 off	100 off
0·001, 0·0015, 0·0022	6d	4/6	9/9	33/4
0·0033, 0·0047	6d	4/6	9/10	33/6
0·0068, 0·01	7d	5/1	10/11	36/5
0·015	7d	5/2	11/10	37/6
0·022	7d	5/3	12/–	37/9
0·033	8d	5/8	12/7	42/7
0·047	9d	6/7	14/5	49/–
0·068	11d	7/8	16/7	51/–
0·1	11d	8/–	17/2	57/4
0·15	1/2	10/3	22/–	74/–
0·22	1/6	14/3	28/5	95/10
0·33	2/3	19/7	42/3	140/7
0·47	2/8	23/4	48/9	165/7

Modular, metallised, P.C. mounting, 250V:
Prices per Capacitance value (μF)

	each	10 off	25 off	100 off
0·01, 0·015	7d	5/2	11/3	38/7
0·022	7d	5/4	11/9	41/8
0·033, 0·047	8d	5/11	12/10	43/9
0·068	9d	6/7	14/1	47/1
0·1	9d	6/9	14/9	51/–
0·15	11d	8/2	18/–	62/6
0·22	1/–	8/9	18/11	63/6
0·33	1/5	12/6	27/–	91/8
0·47	1/8	14/8	31/9	107/10
0·68	2/3	19/10	43/2	146/9
1·0	2/9	23/8	49/8	160/4

CAPACITORS

Subminiature Polyester film, Modular for P.C. mounting. Hard epoxy resin encapsulation. Radical leads.
±10% tolerance. 100V working.
Prices—per Capacitance value (μF)

	each	10off	25 off	100 off
0·001, 0·002, 0·005,	6d	4/3	8/4	30/–
0·01, 0·02	8d	6/–	12/6	41/8
0·05	10d	7/1	15/6	51/–
0·1	1/2	10/–	20/10	68/6
0·2				

Polystyrene film, Tubular, Axial leads. Unencapsulated. ±5% or ±1pf tolerance. 160V working.
Prices—per Capacitance value (μμF)

	each	10 off	25 off	100 off
10, 12, 15, 18, 22, 27, 33, 39, 47, 56, 68, 82, 100, 120, 180, 220, 270, 330, 390	5d	3/7	7/9	24/–
470, 560, 680, 820, 1,000, 1,500	6d	4/–	8/8	26/8
2,200, 3,300, 4,700, 5,600 ..	7d	5/–	10/10	33/4
6,800, 8,200, 10,000, 15,000 ..	8d	6/–	13/–	40/–
22,000	9d	6/9	18/–	45/4

POTENTIOMETERS (Carbon)

Miniature, fully enclosed, rear tags, carbon brush wiper, Long Life, low noise. Body dia, ¾in. Spindle, 1in × ¼in. ½W at 70°C. ±20% below ¼M, ±30% over ¼M. Lin. 100 Ohms to 10 Megohms. Log. 5 Kohms to 5 Megohms.

Prices—per ohmic value	each	10 off	25 off	100 off
	2/–	18/4	41/8	150/–

GANGED STEREO POTENTIOMETERS (Carbon)

½W at 70°C. Long Spindle.
Logarithmic and Linear: 5k + 5k to 1M + 1M.

Prices—per ohmic value	each	10 off	25 off	100 off
	8/–	70/–	162/6	575/–

SKELETON PRE-SET POTENTIOMETERS (Carbon)

High quality pre-sets suitable for printed circuit boards of 0·1in P.C.M. 100 ohms to 5 Megohms (Linear only). Miniature: 0·3W at 70°C. ±20% below ¼M, ±30% above ¼M. Horizontal (0·7in + 0·4in P.C.M.) or Vertical (0·4in × 0·2in P.C.M.). Subminiature: 0·1W at 70°C. ±20% below 2·5M, ±30% above.

Prices—per ohmic value	each	10 off	25 off	100 off
Miniature (0·3W)	1/–	8/9	18/9	66/8
Subminiature (0·1W)	10d	7/1	14/7	46/8

RESISTORS

High stability, carbon film, low noise. Capless construction, molecular termination bonding.
Dimensions (mm): Body: ¼W; 8 × 2·8
½W; 10 × 4·3
Leads: 35
10% ranges; 10 Ohms to 10 Megohms (E12 Renard Series).
5% ranges; 4·7 Ohms to 1 Megohms (E24 Renard Series).
Prices—per Ohmic value.

		each	10 off	25 off	100 off
¼W	10%	2d	1/6	3/3	10/4
¼W	5%	2½d	1/9	3/8	11/8
½W	10%	2½d	1/9	3/8	11/7
½W	5%	3d	2/–	4/–	12/10

SEMICONDUCTORS

Prices

Type	1 off	10 off	25 off	100 off
AC107	3/6	26/3	63/–	232/9
AC127	2/6	18/9	45/–	166/3
AC128	2/6	18/9	45/–	166/3
AD140	8/–	60/–	144/–	533/4
AD149	9/–	67/6	162/–	600/–
AF115	2/6	18/9	45/–	166/3
AF116	2/6	18/9	45/–	166/3
AF117	2/6	18/9	45/–	166/3
BC107	3/6	26/3	63/–	232/9
BC108	3/–	22/6	54/–	199/6
BC109	3/6	26/3	63/–	232/9
BY234	2/9	24/3	52/4	177/–
BY235	3/–	26/3	56/3	187/6
BY236	3/3	28/8	61/9	208/4
BY237	3/6	30/8	65/6	218/9
BY238	3/9	34/4	71/6	227/6
BYZ10	6/–	45/–	108/–	399/–
BYZ11	5/4	40/–	96/–	354/8
BYZ12	4/8	35/–	84/–	310/4
BYZ13	4/–	30/–	72/–	266/–
OA5	2/–	15/–	36/–	133/4
OA81	2/–	15/–	36/–	133/4
OA202	2/–	15/–	36/–	133/4
OC23	7/4	58/8	132/–	497/8
OC25	6/–	45/–	108/–	399/–
OC28	9/–	67/6	162/–	598/6
OC35	6/–	45/–	108/–	399/–
OC44	3/–	22/6	54/–	199/6
OC45	2/6	18/9	45/–	166/3
OC71	2/–	15/–	36/–	133/4
OC72	2/6	18/9	45/–	166/3
OC75	2/4	17/6	42/–	155/4
OC81	2/–	15/–	36/–	133/4
OC81D	2/4	17/6	42/–	155/4
OC82D	2/4	17/6	42/–	155/4
OC139	3/4	25/–	60/–	221/8
OC170	2/6	18/9	45/–	166/3
OC171	2/6	18/9	45/–	166/3
2N2926 (Green)	2/8	20/–	48/–	177/4

Thyristors (5A)—Stud mounting.
Prices

P.I.V.	1 off	10 off	25 off	100 off
100	8/–	60/–	144/–	532/–
200	10/–	75/–	180/–	665/–
400	15/–	112/6	270/–	997/–

VEROBOARD & ACCESSORIES

Prices

	1 off	10 off	25 off
0·15in Matrix			
2½in × 3¾in	3/3	30/–	67/9
2½in × 5in	3/11	35/10	80/9
3¾in × 3¾in	3/11	35/10	80/9
3¾in × 5in	5/6	50/–	114/7
0·1in Matrix			
2½in × 3¾in	4/–	37/8	86/–
2½in × 5in	4/6	42/6	96/3
3¾in × 3¾in	4/6	43/4	100/–
3¾in × 5in	5/6	48/4	111/5
Spot Face Cutter	7/3	...	–
Pin fitting tool	9/6		
Terminal pins	2/– (per 25 off) 6/9 (per 100 off)		

SEND S.A.E. FOR 1969 CATALOGUE

DUXFORD ELECTRONICS (PE)

97/97A MILL ROAD, CAMBRIDGE

Telephone: CAMBRIDGE (0223) 63687

(Visit us—at our new Mail Order, Wholesale and Retail Premises)

MINIMUM ORDER VALUE 5/-

C.W.O. Post and Packing 1/6

S.E.S. YOUR COMPLETE SUPPLIER

196 Regent Road, SALFORD 5, Lancashire

TELEPHONE 061-872 5187

(Member of the Harrop Industrial Group)

C.W.O. please 1/- p. & p. for orders of components under £1
Orders of Lektrokit: 2/- handling charge on orders under £1
5/- handling charge on orders under £5

RESISTORS: All brand new, Hi-Stab, low noise, 5% tol. carbon film. ¼W E12 series 4·7 ohm to 10M, **2d.** each or 15/- per 100 of one value. ¼W E24 series 4·7 ohm to 10M, **2d.** each or 15/- per 100 of one value. ½W E12 series 2·2 ohm to 3·9 ohm, **8d.** each. 1W E12 series 10 ohm to 10M. (10% tol.), **3d.** each. 3W—wirewound—0·5 ohm to 12 ohm, 1/6 each. 5W—wirewound—15 ohm to 8·2kohm, 1/9 each. S.E.S. Pre-Pack gives you 5 off each, 5% resistors from 4·7 ohm to 1M either ¼ or ½ watt. 65 different values (E12)—ONLY **£2 12s. 6d.** ***NOW—½W carbon film 5%, E12 series 10 ohm to 100kohm, **2d. each.**

PRE-SETS: Min. skeleton carbon track, low noise with good stability; Values—Lin: 1k, 2·5k, 5k, etc., to 5M; Log: 5k, 10k, 25k, etc., to 1Mohm, only **10d.** each. Sub-Min skeleton Lin. track: 1k, 2·5k, 5k, etc., to 5M, only **9d.** each. Slider pre-sets wirewound ½W rating Lin: 10 ohm to 5k, 2/3 each. 3W wirewound fully enclosed Lin. tracks. 10 ohm to 30k, **3/9.**

POTENTIOMETERS: Min. enclosed, carbon track and wiper contact only **2/6;** Values—Lin: 1k, 2·5k, 5k, etc., to 10M; Log: 5k, 10k, 25k, etc., to 5Mohm. Min. with double-pole switch, insulated spindles only **5/6.** Values —Lin: 25k, 50k, 100k; Log: 3k, 5k, 10k, 250k, 500k, 1M, 2M. 3W wirewound Lin. tracks 50 ohm to 100kohm, **7/4** each.

CAPACITORS: New genuine Mullard Electrolytics

	(Min.)							(Small)		
6·4V	6·4	25	50	100	200	320	640	1,000	1,600	2,500
10V	4	16	32	64	125	200	400	640	1,000	1,600
16V	2·5	10	20	40	80	125	250	400	640	1,000
25V	1·6	6·4	12·5	24	50	80	160	250	400	640
40V	1	4	8	16	32	50	100	160	250	400
64V	0·64	2·5	5	10	20	32	64	100	160	250
Prices: 1/-				10d. each			1/3	1/6	1/9	2/6

	(Large)					(Multiples)		
25V	800	1,250	2,000	4,000	6,400	500V	8–8μF	6/6
40V	500	800	1,250	2,500	4,000	500V	16–16μF	7/6
64V	320	500	800	1,600	2,500	350V	32–32μF	7/3
Prices:	5/-	6/6	8/-	12/6	15/-	350V	50–50μF	9/-

(all values in Microfarads)

Mullard Miniature Metallised Polyester 250V. 0·01, 0·015, 0·022, 0·033, 0·047, 0·068μF, **6d.** each. 0·1, 0·15, 0·22μF, **7d.** each.
Mullard Polyester Film and Foil 400V. 0·001, 0·0015, 0·0022, 0·0033, 0·0047, 0·0068, etc., to 0·033μF, **6d.** each. 0·047 to 0·1μF, **8d.** each. 0·15μF, **10d.** 0·22μF, 1/-. 0·33μF, 1/6. 0·47μF, 1/9.
Disc Ceramics (Erie) 500V, 1,000, 4,700pF, **5d.** each. Silver Micas 1% tol. 500V, 2·2pF to 820pF, 1/- each. Polystyrene 160V, 100–1,000pF, **5d.** each. *** NOW—Bead Tantalums (polarised) 35V, 0·47, 0·68, 1μF, **2/6** each. 2·2, 3·3, 4·7, 6·8μF, **3/4** each. 20V 10μF, 15V 22μF, 10V 33μF, 6V 47μF, **3/9** each. Low Voltage Disc Ceramics 20V—0·01, 0·022, 0·047μF, **10d.** each. 0·1, 0·22, **1/3** each. Midget Tubular Ceramics—0·002, 0·003μF, **10d.** each.

SEMICONDUCTORS: All New and Unused
Mullard; OA5, **4/6;** OA81 **3/4;** OA202 **2/3;** OC71 **4/-;** OC72 **4/6;** OC44 **7/9;** OC45 **6/-;** BC107, 109 **3/9** each; BC108 **3/6;** BFY51 **4/6;** MPF 105 **9/6.** Silicon Rectifiers—(0·5A) 400piv **2/9;** 800piv **3/-;** 1,500 piv **3/6;** (1·2A) 400piv **6/-;** 800piv **7/-;** 1,500piv **7/6;** (2·5A) 400piv **6/6;** 800piv **7/6;** 1,500piv **10/6.** (1·2A and 2·5A types are stud mounted—Anode). ***NOW—2N2924 **3/6;** 2N2926 (Brown or Red) **2/6,** (Orange) **2/9,** (Yellow) **3/-,** (Green) **3/3;** 2N3643 **8/6;** 2N3794, 2N4289 **4/-** each; 1N4148 **1/6.**

SWITCHES: 100 series—SPST **3/8;** SPDT **3/11;** DPST **4/6;** DPDT **4/8.** 400 series SPST **3/2;** SPDT **3/6;** SPDT (with centre position) **3/8.** Series 500—push-to-make or push-to-break **3/11** each (push buttons available in white ' red, black, green). Slide Switch **3/4;** Wave Change switches **5/9** each. Miniature "Maka-Switch" also available—Shafts **5/-;** Wafers **5/4** each.

PLUGS AND SOCKETS: Min. Plugs (black or red) **6d.** Min. Sockets to fit **7d.** Banana Plugs (black or red) **9d.** 4mm Sockets to fit (black, red, green) **9d.** Co-Ax Plugs **1/2.** Co-Ax Sockets **11d.** Sub-Min Jack Plugs and Sockets **2/-** each. Min. Jack Plugs and Sockets **3/-** each. Recorder Plugs 3-way **2/7** 5-way **3/-.** Recorder Sockets 3-way **1/2,** 5-way **1/4.**

WIRE: Min. Stranded (available in 10 colours) **3d.** yd. Solid Core **3d.** yd. 14/0·0076in. Stranded **4d.** yd. Min. Mains Lead **1/3** yd. Min. Microphone cable **1/6** yd. Co-Ax cable **1/3** yd.

LAMPS: Min. Wire Ended Neons **2/-;** Panel Neon Indicator **6/4;** Pilot Light +12V bulb **8/-;** Min. Flange Light +12V bulb **11/-.**

SOLDERING IRONS: A.N.T.E.X. CN240 15W mains operated, small, **32/6.** E240 20W mains operated, specially shaped handle, **35/-.** Spare bits and elements available. Also stands for above irons, **11/6** each. ***NOW—SOLDER by Multicore—at Reduced Prices to Everyone! Size A—Approx. 20ft coil 60/40 Alloy 22 s.w.g. in dispenser. Recommended retail price **3/-**, OUR PRICE **2/9.** Size B—Approx. 200ft reel 60/40 Alloy 22 s.w.g. individually packed. Recommended retail price **15/-**, OUR PRICE **12/6.** BIB Wire Strippers: strips insulation without nicking wire. Recommended retail price **4/6,** OUR PRICE **4/-.**

LEKTROKIT: Chassis construction system—the professional look to a home construction. Parts to build a chassis 8¾ × 4¾in.—2 chassis rails **1/10** each. 2 side plates **4/4** each. Front panel (covered in crack-proof paint) **8/3.** Perforated cover **5/5.** 2 plain covers **4/5** each. 4 rubber feet **9d.** 7 boards available each 4¾ × 4in.—Thus 2 boards fit above chassis. Plain perforated aluminium board **2/2.** Aluminium board drilled for 6 valveholders B7G, B8A, B9A, **2/6.** Aluminium board drilled for 2 valveholders international octal, UX4, etc., **2/4.** 0·1in. perforated grid SRBP board, **2/9.** Veroboards 0·1in. and 0·2in. **6/6** each. Cloverleaf aluminium board **6/-.** (Cloverleaf lead throughs **6d.** each. Pins for SRBP board 4/6 100.)

For full details of all our stocks send 3/6 for our bright explanatory 120 page catalogue, or 6d. stamp for Data Sheets.

Become a RADIO TECHNICIAN

and work at the nerve centres of civil aviation

The National Air Traffic Control Service of the Board of Trade, needs Radio Technicians to install and maintain the very latest electronic aids at Civil Airports, Air Traffic Control Centres, Radar Stations and specialist establishments. Vacancies exist in various parts of the United Kingdom.

This is responsible demanding work (for which you will get familiarisation training) involving communications, computers, radar and data extraction, automatic landing systems and closed-circuit television. It offers excellent prospects with ample opportunities to study for higher qualifications in this fast-expanding field.

If you are 19 or over, with practical experience in at least one of the main branches of telecommunications, fill in the coupon now.

Salary from January 1st 1970 is £985 (at 19) to £1,295 (at 25 or over): scale maximum £1,500 (higher rates at Heathrow), and some posts attract shift-duty payments. The annual leave allowance is good and there is a non-contributory pension scheme for established staff.

Complete this coupon for full details and application form:
To: Mr. A. J. Edwards, C. Eng., M.I.E.E., M.I.E.R.E., Room 705, The Adelphi, John Adam Street, London WC2, marking your envelope 'Recruitment'.

Name.....

Address.....

.....PE/B2

Not applicable to residents outside the United Kingdom.

NATCS National Air Traffic Control Service

Practical Electronics Classified Advertisements

FOR SALE

SEEN MY CAT? 5,000 items. Mechanical and Electrical Gear, and materials. S.A.E. K. R. WHISTON, Dept. PE, New Mills, Stockport.

500 MORGANITE 100KOHM EDGEWISE POTENTIOMETERS. Type 56N White. Brand new surplus to requirement. Price **£50** for all 500 or **3/6d** each, postage paid. WILKINSON & SON, "Carinya," Bell Lane, Nuthampstead, Royston, Herts. Tel.: Barkway 553.

RECHARGEABLE NI-CAD CELLS. 1·22V, 5A.H. 3·625in × 1·25in diameter **12/6** each, 3 cells in case **35/-**; BTY79 400V 4·7A SCR **12/6**; BY100 **4/-**. GALPIN, 37 Canfield Road, Rainham, Essex.

MINIATURE DYNAMIC MICROPHONES. High impedance, size $\frac{7}{8} \times \frac{5}{8} \times \frac{5}{16}$in. Also work as mini speakers, suit transistor circuits, **7/6** each, 3 for **20/-**. Tested, guaranteed. Ardente 10kΩ edgewise volume controls, **3/6** each, 3 for **10/-**. DREW, 77 The Crescent, Southwick, Sussex.

MORSE MADE EASY !!

FACT NOT FICTION. If you start **RIGHT** you will be reading amateur and commercial Morse within a month (normal progress to be expected).

Using scientifically prepared 3-speed records you automatically learn to recognise the code **RHYTHM** without translating. You can't help it, it's as easy as learning a tune. 18 W.P.M. in 4 weeks guaranteed.

For details and course C.O.D. ring S.T.D. 01-660 2896 or send 8d. stamp for explanatory booklet to:

G3HSC (Box 19), 45 GREEN LANE, PURLEY, SURREY

SERVICE SHEETS

RADIO TELEVISION, over 8,000 Models. JOHN GILBERT TELEVISION, 1b Shepherds Bush Rd., London, W.6. SHE 8441.

SERVICE SHEETS (1925-69) for televisions, radios, transistors, tape recorders, record players, etc., by return post, with free fault-finding guide. Prices from **1/-**. Over 8,000 models available. Please send S.A.E. with all orders/enquiries. HAMILTON RADIO, 54 London Road, Bexhill, Sussex.

SERVICE SHEETS, Radio, TV, 5,000 models. List **1/6.** S.A.E. enquiries. TELRAY, 11 Maudland Bank, Preston.

MISCELLANEOUS

HI-FI loudspeaker systems for the home constructor, cabinet kits, the new range of Peerless speakers, speaker kit systems and cross-over networks. BAF wadding, speaker fabric (samples on request) and all other necessary components. Send 5d in stamps to: AUDIOSCAN, Dept. PE, 4 Princes Square, Harrogate, Yorks.

MUSICAL MIRACLES. Send S.A.E. for details of Rhythm Modules, Versatile Bass-pedal unit, self-contained with unique effects, kits for waa-waa pedals. Also new 50μA meters **25/-** post paid. HURRY! D.E.W. LTD. 254 Ringwood Road, Ferndown, Dorset.

UFO DETECTOR CIRCUITS, data. 10s. (refundable). Paraphysical Laboratory (UFO Observatory), Downton, Wilts.

BATTERY ELIMINATORS

The ideal way of running your TRANSISTOR RADIO, RECORD PLAYER, TAPE RECORDER, AMPLIFIER, etc. Types available: 6v, 9v, 12v, 18v (single output) 39/6 each. P. & P. 2/9. 9v + 9v; 6v + 6v; or 4½v + 4½v (two separate outputs) 42/6 each. P. & P. 2/9. Please state output required. All the above units are completely isolated from mains by double wound transformer ensuring 100% safety.

R.C.S. PRODUCTS (RADIO) LTD.
(Dept. P.E.), 31 Oliver Road, London, E.17

MISCELLANEOUS *(continued)*

PRACTICAL ELECTRONICS ORGAN. Complete set of capacitors and resistors as listed in 2nd article (June issue). Also 12 Vinkor inductors and 12 printed divider boards. All new and unused. Cost over £50. Offers: G. HIRST, 21 Westport Road, Cleethorpes, Lincs. Humberston 3619.

MORE ROBOTS

Synthetic Animals with "BRAINS" of their own. The LATEST range of projects include: an electronic 'animal' which "LEARNS", and an Electro Chemical device capable of "REPRODUCING" itself! Other projects SURE TO INTRIGUE YOU are a transmitter/receiver which has quite a useful range and RADIATES WITHOUT USING R.F. also TEN new projects, one of which is an electronic dice machine. HOSTS OF EASY-TO-CONSTRUCT projects, for anyone with a basic knowledge of Electronics. DON'T WAIT. SEND 3/- for your list—NOW!

To: 'BOFFIN PROJECTS'
4 CUNLIFFE ROAD
STONELEIGH, EWELL, SURREY
Designed by GERRY BROWN and JOHN SALMON and presented on T.V.

LONDON RADIO CONTROLLED MODELS SOCIETY

Meetings 2nd Thursday each month, 7.30 p.m. "The Two Chairmen", Dartmouth St., London, S.W.1. All aspects of Radio Controlled Models. Beginners and experts welcomed, come along, or phone 369-3568 or 907-6271 for more information.

PSYCHODELIC LIGHTING UNIT. A brand new design that adds a new dimension to music. Ideal for use by pop groups and disco's. Used in conjunction with a record player it can turn a house party into a psychodelic freek out! It modulates up to 1·5kW of light and sensitivity is fully variable. Money back if not "turned on". They come complete with instructions either as a kit or ready built and tested. Kit form: **14 gns;** Built: **16 gns** (inc. P/T). Send now to: SOUND ELECTRONICS, 30 Second Avenue, Newcastle upon Tyne, NE6 5XS. For further details send S.A.E.

5% RESISTORS 3d EACH

Extremely Reliable, Hi Stab. Carbon Film, ½ Watt. All Values 10Ω to 1MΩ

OC71	1/9	2N2926	1/9	OC202	1/9
OC45	1/9	ZTX300	1/9	BC108	1/9

All the above types are available at 16 for **£1.** Brand new, individually tested.

MONEY BACK GUARANTEE P. & P. 1/-

J. M. KING
14 Acton Street, London, W.C.1

MISCELLANEOUS *(continued)*

ETCHED PRINTED CIRCUIT BOARD KITS. Full instructions. **19/6,** c.w.o. CIRCUITETCH, 12 Cambridge Rd., St. Albans, Herts.

A CORNUCOPIA OF COMPONENTS! Scarce valves, selected TV Components, Educational and Projects kits, Speakers and Cabinets, Transistors, Resistors and values, ½ watt, **3d** each. State your requirements. S.A.E. for details. MAIL-MART, 6 Eastbourne Road, Pevensey Bay, Sussex.

NOTES ON USE OF TV for Aircraft or UFO Detection. Optical Detector Set and Instructions, **7/6** each. RADAR & ELECTRONICS PUBLICATIONS, 1 Stowmarket Road, Needham Market, Suffolk.

BUILD IT in a DEWBOX quality cabinet 2in × 2½in × any length. DEW LTD., Ringwood Road, Ferndown, Dorset. S.A.E. for leaflet. Write now—right now.

RADIO AND ELECTRONIC KITS ASSEMBLED, moderate charges, S.A.E. with enquiries. COLTHARD, Bun-Atha, Taynuilt, Argyll.

UNTESTED UNMARKED TRANSISTORS. Mixed Germ *pnp* Types Equiv. OC, 44, 45, 71, 72, etc. 10—**2/9**, 50—**12/6**, post free. Limited stocks. D. G. PERRY, Graymare, Lostwithiel, Cornwall.

BARGAIN PACK. 200 assorted springs, nuts, washers, screws. Popular sizes **7/6,** including postage. COHAVEN, Industrial Estate, Ripley, Derbyshire.

LUMINOUS ZINC SULPHIDE, Stannous Chloride for Electroluminescent Panels (November PRACTICAL ELECTRONICS). Many other chemicals available. S.A.E. for list. KEMCO, 22 Kemerton Road, London, S.E.5. Mail Order Only.

SCRAP R F. HEATING AND TRANSMITTING VALVES wanted. TY5-500, TY6-800, TY7-600, ESA1500, 3J202E. May be interested in other types. Good price paid for valves still under vacuum. ELECTRONIC HEAT CO. (01-654 7172).

6 OR 12 VOLT FLUORESCENT LIGHTS

12 ins. 8 Watt tube ample light for caravan, tent, etc. Fully transistorised, low battery drain

Unbeatable at **£2.19.6** post paid.

or in kit form **50/-**

4 WATT GRAM AMPS.

Volume and tone controls, mains operation, 3Ω output, new and boxed **65/-** POST PAID

SALOP ELECTRONICS Callers welcome
23 Wyle Cop
Shrewsbury, Shropshire *S.A.E. for lists*

PHOTO ETCHED PRINTED CIRCUIT BOARDS for all P.E. Projects. Time lapse cine November 1969 **6/6,** P.E. Organ oscillator June 1969 **5/0.** Send S.A.E. for full list. Your own circuit boards etched for **2d.** per square inch, plus postage. CASTLE LABORATORIES, 32 Stapleton Close, Highworth, Wilts.

EDUCATIONAL

LEC

RADIO & TELEVISION SERVICING
RADAR THEORY & MAINTENANCE
TELECOMMUNICATIONS

This private College provides efficient theoretical and practical training in the above subjects. One-year day courses are available for beginners and shortened courses for men who have had previous training. Write for details to:—

The Secretary, London Electronics College, 20 Penywern Road, Earls Court, London, S.W.5. Tel. 01-373 8721

GET INTO ELECTRONICS—big opportunities for trained men. Learn the practical way with low-cost Postal Training, complete with equipment. A.M.I.E.R.E., R.T.E.B., City & Guilds, Radio, T/V, Telecoms., etc. For FREE 100-page book, write Dept. 856K, CHAMBERS COLLEGE, College House, 29-31 Wrights Lane, Kensington, London, W.8.

TECHNICAL TRAINING in Radio, TV & Electronics thro' world-famous ICS. For details of proven home-study courses write: ICS, Dept. 561, Intertext House, Stewarts Road, London, S.W.8.

ENGINEERS. A technical certificate or qualification will bring you security and much better pay. Elem. and adv. private postal courses for C.Eng., A.M.I.E.R.E., A.M.S.E. (Mech. & Elec.), City & Guilds, A.M.I.M.I., A.I.O.B. and G.C.E. exams. Diploma courses in all branches of Engineering—Mech., Elec., Auto, Electronics, Radio, Computers, Draughts., Building, etc. For full details write for FREE 132-page guide. BRITISH INSTITUTE OF ENGINEERING TECHNOLOGY (Dept. 125K), Aldermaston Court, Aldermaston, Berks.

CITY & GUILDS AND R.T.E.B. EXAMS. Specialised ICS home-study course will ensure success. For details of wide range of exam. and diploma courses in Radio, T.V. and Electronics, also new practical courses with kits, write to ICS (Dept. 577), Intertext House, Stewarts Road, London, S.W.8.

BOOKS AND PUBLICATIONS

SURPLUS HANDBOOKS

19 set Circuit and Notes	**6/6** P.P. 6d
1155 set Circuit and Notes	**6/6** P.P. 6d
H.R.O. Technical Instructions ..	**5/6** P.P. 6d
38 set Technical Instructions....	**5/6** P.P. 6d
46 set Working Instructions....	**5/6** P.P. 6d
88 set Technical Instructions....	**7/–** P.P. 6d
BC. 221 Circuit and Notes	**5/6** P.P. 6d
Wavemeter Class D Tech. Instr	**5/6** P.P. 6d
18 set Circuit and Notes	**5/6** P.P. 6d
BC.1000 (31 set) Circuit & Notes	**5/6** P.P. 6d
CR.100/B.28 Circuit and Notes	**10/–** P.P. 9d
R.107 Circuit and Notes.....	**7/–** P.P. 6d
A.R.88D. Instruction Manual....	**18/–** P.P. 6d
62 set Circuit and Notes	**6/6** P.P. 6d
52 set Sender & Receiver Circuits	**7/6.** post free

Circuit Diagrams 5/– each post free. R.1116/A, R.1224/A, R.1355, R.F. 24, 25, & 26. A.1134, T.1154, CR.300, BC.342. BC.312. BC.348.J.E.M.P. BC.624. 22 set.

Colour Code Indicator ..... **2/6** P.P. 6d

S.A.E. with all enquiries please.
Postage rates apply to U.K. only.
Mail order only to:

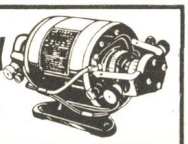
Instructional Handbook Supplies
Dept. P.E., Talbot House, 28 Talbot Gardens
Leeds 8

HOLIDAYS

HOLIDAY FOR BOYS. 14/16 years August 1970, specialising in engineering, electronics, photography. Tuition and practical work including karting. 11 days—**£14 10s.** Write for free brochure: INTER-SCHOOL CHRISTIAN FELLOWSHIP, 47 Marylebone Lane, London, W1M 6AX.

ELECTRICAL

240 VOLT ELECTRICITY ANYWHERE



BEST EVER 200/240 VOLT "MAINS" SUPPLY FROM 12 VOLT CAR BATTERY

Exclusive World Scoop Purchase. The fabulous **Mk.2D American Heavy Duty Dynamotor Unit** with a **Massive** 220 watt output and giving the most **Brilliant** 200/240 volt performance of all time. Marvellous for **Television, Drills, Power Tools, Mains Lighting, AC Fluorescent Lighting** and all 200/240 volt Universal AC/DC mains equipment. Made at tremendous cost for U.S.A. Govt. by Delco-Remy. This magnificent machine is unobtainable elsewhere. **Brand New** and **Fully Tested. Only £4.19.6** + 10/6 postage. C.O.D. with pleasure, refund guarantee. Please send S.A.E. for illustrated details.

Dept. PE, STANFORD ELECTRONICS
Rear Derby Road, North Promenade
BLACKPOOL, Lancashire

SITUATIONS VACANT

A.M.I.E.R.E., A.M.S.E. (Elec.), City & Guilds, G.C.E., etc., on "Satisfaction or Refund of Fee" terms. Wide range of Home Study Courses in Electronics, Computers, Radio, T.V., etc. 132-page Guide—FREE. Please state subject of interest. BRITISH INSTITUTE OF ENGINEERING TECHNOLOGY (Dept. 124K), Aldermaston Court, Aldermaston, Berks.

TECHNICIAN required for general service and prototype work in connection with hi fi and radio control systems. Interesting work. Write for appointment to TELERADIO ELECTRONICS, 325 Fore Street, Edmonton, N.9.

HENRY'S RADIO LTD.
303 EDGWARE RD., LONDON, W.2
HAVE THE FOLLOWING VACANCIES IN THEIR ORGANISATION

SALES ASSISTANTS
Young man with good general knowledge of electronic components required for our retail sales Dept. Please Telephone 723-1008/9 Ext. 1.

SALES ASSISTANTS HI-FI DEPT.
Young man with a good general knowledge of HIGH FIDELITY EQUIPMENT required for our retail HI-FI SALES DEPT. Please contact MR. STEVENS Telephone 723-6963

SKILLED OR SEMI-SKILLED ENGINEER required for service electronic department of large photographic importers. Congenial conditions, interesting work, good salary and L.V.'s. For appointment telephone 253-8031 Mr. Vassey.

ICS

TECHNICAL TRAINING IN RADIO, TELEVISION AND ELECTRONIC ENGINEERING

ESTABLISHED 1891

First-class opportunities in Radio and Electronics await the **I C S trained man.** Let I C S train YOU for a well-paid post in this expanding field.

I C S courses offer the keen, ambitious man the opportunity to acquire, quickly and easily, the specialized training so essential to success. Diploma courses in Radio/TV Engineering and Servicing, Electronics, Computers, etc. Expert coaching for:

* **C. & G. TELECOMMUNICATION TECHNICIANS' CERTS.**
* **C. & G. ELECTRONIC SERVICING.**
* **R.T.E.B. RADIO AND TV SERVICING CERTIFICATE.**
* **RADIO AMATEURS' EXAMINATION.**
* **P.M.G. CERTIFICATES IN RADIOTELEGRAPHY.**

Examination Students coached until successful.

NEW SELF-BUILD RADIO AND ELECTRONIC COURSES
Build your own 5-valve receiver, transistor portable, signal generator, multimeter and valve volt meter—**all under expert guidance.**

POST THIS COUPON TODAY and find out how I C S can help YOU in your career. Full details of I C S courses in Radio, Television and Electronics will be sent to you by return mail.

MEMBER OF THE ASSOCIATION OF BRITISH CORRESPONDENCE COLLEGES

INTERNATIONAL CORRESPONDENCE SCHOOLS

A WHOLE WORLD OF KNOWLEDGE AWAITS YOU!

International Correspondence Schools
(Dept. 152), Intertext House, Stewarts Road,
London, S.W.8.

NAME .....
Block Capitals Please

ADDRESS .....

.....

..... 1.70

GEC-Marconi Electronics

ELECTRONIC TECHNICIANS

are required to work on calibration, fault-finding and testing of telecommunications measuring instruments. The work is varied and will enable technicians with experience of r.f. circuits to broaden their knowledge of the latest techniques employed in the electronics and telecommunications industries by bringing them into contact with a wide range of the most advanced measuring instruments embracing all frequencies up to u.h.f.

Entrants may be graded as Testers, Test Technicians, Senior Test Technicians and Technician Engineers according to experience and qualifications. Our expanding production and servicing programme, geared to our recognised export achievement, provides security of employment combined with good prospects of advancement, not only within these grades, but into other technical and supervisory posts within the Company at St Albans and Luton.

Salaries are attractive and conditions excellent. A Pension Scheme includes substantial life assurance cover provided by the Company. Assistance with removal may also be given in appropriate cases. Please write or telephone for application forms to:

mi

Mr. P. Elsip,
Personnel Officer,
Marconi Instruments Ltd,
Longacres, St. Albans, Herts.
Tel: St. Albans 59292

THE QUEEN'S AWARD TO INDUSTRY

Member of GEC-Marconi Electronics

R & R RADIO

51 Burnley Road, Rawtenstall
Rossendale, Lancs

Tel.: Rossendale 3152

VALVES BOXED, TESTED & GUARANTEED

BF80	3/-	PCC84	3/-	PY81	3/6
EBF89	3/6	PCF80	3/-	PY82	3/-
ECC82	3/-	PCF82	3/6	UI91	4/6
ECL80	3/-	PCL82	4/-	6F23	5/-
EF80	1/6	PCL83	4/-	30F5	2/6
EF85	3/-	PL36	5/-	30L15	5/-
EY86	4/-	PL81	4/-	30P12	4/6
EZ40	4/6	PL83	4/-	30C15	5/-
EBC41	4/6	PY33	5/-	50CD6G	7/6

Transistor Audio Pack, 2G339A, 2G381A, 2G371B 10/- each post 6d.

POST, ONE VALVE 9d. TWO TO SIX 6d.
OVER SIX POST PAID.

ARE YOU HAVING DIFFICULTY in obtaining the components you require? We specialise in the supply of many thousands of types. Send your requirements with S.A.E. for return post quotation. Also three 13A scopes at **£17 10s.** E.A.R., 10 Sycamore Avenue, Cattedown, Plymouth, Devon.

PRINTED CIRCUIT BOARDS for P.E. PROJECTS
All boards drilled and roller tinned complete with layout drawing.
EXAMPLES
Waa-Waa pedal Vol 4 No.7 **2/9d.** ea. Audio Sig. Gen. (Sine and Square on one board) Vol 5 No. 10 **8/6d.** ea. Mic. Mixer (3 Boards) Vol 5 No. 4 **12/-d** Set. Stockmarket Vol 4 No. 12. Central S.E. **6/-d.** ea. Players **3/-d.** ea.
S.A.E. For List.' Trade enquiries welcomed.
P.H. ELECTRONICS, Industrial Estate, Sandwich, Kent. Tel. 2517.

TO HELP THE HOME CONSTRUCTOR. Heathkit now make available our surplus Resistors, Capacitors, etc. at Bargain Prices. Send for lists. E. MOYLE, Daystrom Ltd., Gloucester.

TAPE HEADS

BSR BRAD. 2-TRACK	39/6 pair	REUTER — COLLARO ERASE 4-TRACK	12/6
BSR MARR. 4-TRACK	39/6 pair	BOGEN ERASE UL218/6 4-TRACK	25/-
MICHIGAN REC./PLAY MED. IMP. 4-TRACK	35/-	COSMOCORD ERASE T.E. 2/9 4-TRACK	12/6

TRANSISTOR LW/MW/FM TUNER CHASSIS
The most compact three-band Tuner chassis ever engineered. Output 50mV, exceptional sensitivity and selectivity on all bands. Operates from single 9 volt battery. Complete with aerials, 3-band tuning dial, mounting bracket circuit and instructions. **£13**

TUNER DULCI FMT7S STEREO LIST £31 FEW ONLY AT **£23**
Sens. 14mV, O.P. 100mV, 88-108 m/c, dim. 13¾ × 2¾ × 7".

COMPACT TRANSISTOR FM TUNER
Oiled Walnut cabinet, brushed gold front panel, vertical styling, internal batteries. Sensitivity: Better than 10uV. Audio Output: More than 500 m/v (input level 25db). Signal to Noise Ratio: More than 35db (input level 25db). 6 Transistors, 3 diodes. **£8.19.6**

FM MULTIPLEX STEREO ADAPTOR
Printed circuit biscuit, 4 trans. 6 diodes 9V with full instructions **£4.19.6**

LOUDSPEAKERS

GUITAR, P.A., or HI-FI 12" 25 watt, 15 ohm, 25-13K, Ceramic **£5.7.0**

10" 10 watt, 15 ohm, CERAMIC — MAGNET	49/6	2" 40 ohm 2½" 80 ohm	6/6

SPEAKER CABINET £8
Takes 12" or 10" Speaker and a 4" or 3" Tweeter. Ht. 21", W. 15", D. 7½". Polished Teak, matching vynair grille, list price £9.5.0.

CABINET Teak 23¾ × 13½ × 9½", contemp. 12" legs for Tape Recorder and Tuner or Amplifier, etc. **89/6**
4 pole changeover, ideal for models.

RELAYS 1¼ × 1¼ × ¾", 700 ohm 9-24v, 185 ohm 6-12v, 430 ohm 9-18v **10/-**

TWEETER 3" 16 ohm, 10 watt crossover 3k Ω, 18,000 c/s **19/6**
Horn type Hi-Fi

CROSSOVER NETWORK 3kc/s, 16 or 3 or 8 ohm. **15/-**

CHARGER RECTIFIERS	**CHARGER TRANSFORMER.**
F.W. 12 volt 1 Amp. **5/-**	2/6/12 volt, 3/- P/P
F.W. 12 volt 4 Amp. **10/6**	1A **13/-**, 2A **16/6** 4 Amp **21/6**

SUPER SILICON RECT. T.V., etc., 1,200 PIV 800mA, **5/-**; or complete with instr. resistor, condenser, **6/6**; 400 PIV HW 6A, **6/-**.

MULTIMETERS from **32/-**

TRANSISTORS
2N3638A **5/-**, 2N3643 **5/6**, AC138 **5/-**, AC141 **5/-**, ACY20 **3/8**, ACY21 **4/-**, AF178 **11/8**, AF186 **10/-**, BC108 **2/6**, BC109 **2/6**, BCY33 **4/6**, BF181 **7/-**, NKT213 **5/6**, NKT226 **5/6**, OA91 **1/6**, OAZ270 **3/6**, OC45 **2/-**, OC81D **2/3**, OC82 **4/-**, OC200 **3/3**. GET103–113–118–119–887–889–890–896–7–8 **3/-**

SWITCH ROTARY RECIPROCATING 4 Position, 15amp. Single hole fixing, with instructions. List 14/7 **5/6**
C60 CASSETTE **10/3**. C90 **14/3**. 3 Post free

Stamped envelope for full selection and bargain offers in MULTIMETERS, RADIOS, BABY ALARMS, INTERCOMS, WALKIE-TALKIES, RECTIFIERS, SINCLAIR, DULCI.
UNDER £1—P. & P. 6d., £1 to £3—1/6, over £3—2/6.
C.O.D. 3/6. MAIL ORDER ONLY. U.K. ONLY

DURHAM SUPPLIES
367 KENSINGTON STREET
BRADFORD 8, YORKSHIRE

NEW VHF KIT

Receives Television Sound, Ambulances, Aircraft, Radio 2, 3 and 4 on VHF, etc.

This novel little set will give you endless hours of pleasure and can be built in one evening. The Kit comes with easy to follow instructions and circuit. Powered by 9v Battery. Complete with built in Jack Plug Socket for use with Earphones or Amplifier.

ONLY 57/-. P. & P. FREE U.K. ONLY

Postal Orders, Cheques to
Dept. P.E.5
Galleon Trading Co., 298A Lodge Lane, Romford, Essex

Single channel Radio Control at a price you can afford

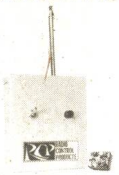
RADIO CONTROL PRODUCTS

EXCELLENT RANGE AND PERFORMANCE

TRANSMITTER—

- Crystal controlled tone Tx. 12v. operation. Silicon transistors. In smart case with micro-switch.

Tx only **£6 - 5 - 0**



RECEIVER—

- Sub-miniature Wt 40 grms.

Size only 3·5 × 2·8 × 2 cms.

Working voltage 4·5v.

Rx only **£4 - 5 - 0**

SUITABLE FOR MODELS OF ALL KINDS
ONLY £10 - 10 - 0 COMPLETE

DIRECT FROM **RADIO CONTROL PRODUCTS**
38 FRANCHE ROAD
KIDDERMINSTER, WORCS.

WE ARE BREAKING UP COMPUTERS

EX COMPUTER PRINTED CIRCUIT PANELS 2in × 4in packed with semi-conductors and top quality resistors, capacitors, diodes, etc. Our price, 10 boards **10/-**. P. & P. 2/-. With a guaranteed minimum of 35 transistors.

SPECIAL BARGAIN PACK. 25 boards for **£1**. P. & P. 3/6. With a guaranteed minimum of 85 transistors. 100 boards **55/-**. P. & P. 7/6. With a guaranteed minimum of 350 transistors.

GIANT PANELS. 5½in × 4in, min. 20 transistors, 9 × 56 μH inductors, resistors, diodes, etc. 3 for **£1**. P. & P. 2/-.

As above, only 21 transistors, 70 diodes, 62 min. ⅛th.W resistors. 3 for **25/-**. P. & P. 2/-.

PANELS with 2 power transistors sim. to OC28 on each board +components. 2 boards (4 × OC28) **10/-**. P. & P. 2/-.

TRIM POTS. On 2in × 4in boards +Ta caps and other components. Ideal for organ key-board tuning, etc. 100Ω, 500Ω, 15K., 20K. State requirements. 5 boards **10/-**. P. & P. 2/-.

NPN GERMANIUM TO5 1 WATT POWER TRANSISTORS. On small heat sink, on 2in × 4in panel. 5 for **10/-**. P. & P. 2/-.

POWER TRANSISTORS. Sim. to 2N174 ex-eqt. On Finned Heat Sink (10D). 4 for **£1**. P. & P. 5/-.

DIODES. Ex eqpt., Silicon, 150 PIV, 10 amp 4 for **10/-**. 150 PIV, 20 amp. 4 for **£1**. Post free.

OVERLOAD CUT OUTS. Panel mounting in the following values . . . **5/-** each. 3, 4 amp. P. & P. 1/-.

MINIATURE GLASS NEONS, 13/6 doz.

PAPST FANS. Powerful Extractor/Blower fans. 4½" × 4½" × 2". 230/250V. 100 c.f.m., 2,800 r.p.m. **50/-** post free.

MICRO SWITCHES. Miniature button type. **10/-** doz. P. & P. 1/6.

NEW SPRAGUE. 0·22μF 250V small capacitors. **5/-** doz. P. & P. 1/-.

NEW SPRAGUE ELECTROLYTICS. 4μF 150V. **5/-** doz. P. & P. 1/-.

NON-POLAR TANTALUM CAPS. 2.2μF 50V. **10/-** doz. P. & P. 1/-.

LARGE CAPACITY ELECTROLYTICS. 4½in, 2in diam. Screw terminals. **7/6** each post free.

4,000μF	72V d.c. wkg.
10,000μF	25V d.c. wkg.
25,000μF	12V d.c. wkg.

4½" × 1¾". Plessey 5,000μF 55V d.c. wkg. **8/-** each. 3" × 1" Plessey 2,000μF 25V d.c. wkg. **6/-** each. 4½"" × 1½" screw terminals 2,500μF 55V d.c. wkg. **6/-** each.

KEYTRONICS, 52 Earls Court Road
London, W.8. Mail order only
Tel. 01-478 8499

PLASTIC PLANARS. BC183L, 30V, 300mW, high gain, 5 for **10/-**. STANIER, 74 Grange Road, Belmont, Durham.

TRANSISTOR PANELS

INTEGRATED CCT'S TAKEN FROM PANELS

A — Quad 2 I/P Gate	5/-	With Pin
B — Dual 4 I/P Gate	5/-	Connections
C — Dual 2 Level Gate	5/-	
F — Single I/P Gate	5/-	Post Paid

EX GOVMT. RECEIVER R.209 covering 1—20 mc/s 12V D.C. Input **£12.10.0** Post Paid (Tested).

50 VARIOUS TRANSISTORS on Panels **15/-** Post Paid.

20—OC45	£1
20—OC76	£1
40—TK28c	£1

COMPUTER PANELS with 40 sil. pnp or npn transistors, Diodes and res., **22/6** Post Paid.

COMPUTER PANELS WITH SEMI-CONDUCTORS. Postage 6d per panel

8—OC43 or GET875 + 24—OA81	7/6
24—A1678 (V405A) 550 mc/s PNP + 24 Diodes	15/-
4—OC170 + 2—OC139 + 2—OC42	7/6
9—ASZ20 + 1—T2040 + 27 Diodes	7/6
4—OC42 + 6—GET875 + Diodes	7/6
2—OC170 + 1—2G306 + OC42	4/-
5—OC23 + 15—OA10	25/-
8—ASZ20 + 80 Diodes	7/6
6—ASZ21 + 15—OA91	6/-
9—SB240 + 18—OA47	10/-
12—2G106 + 24 Diodes	9/6
8—OC72 + 8—OA10	10/-
8—OC76 + 8—OA10	7/6
12—A1678 (V405A) 550 mc/s PNP + 22 Diodes	10/-
36—OA5	6/-
6—GET872 + 8—OA10	5/-
4—OC42	3/-
12—ASZ20 + 80 Diodes	9/6
4—GET872 + 8—OA10	3 for 12/-
4—2G106 + 1—2N2410	4/-
2—OC42 + 8—OA47	3/-
2—GET872 + 4—OA10 + RF Chokes	3 for 10/-
24—Sil. h.f. Transistors	15/-
3—GET872 + 3—GEX541, ETC.	22/6
3—OC23 + 6—OA10 + 2—OA5	16/-

ELECTROLYTICS 25,000 @ 12V, 16,000 @ 12V, 15,000 @ 10V, 10,000 @ 30V, 4,000 @ 60V, 2,000 @ 50V, 1,200 @ 180V, **8/6** Post Paid.

ZENER DIODES—2·4, 2·7. 3·6. 4·75, 6·2, 6·8, 7·5, 13, 15, 16, 18, 20, 27, 30, 33 volts. **3/6** each, mostly 1 watt

POLYSTYRENE CAPACITORS. 125V, 18, 22, 120, 220, 270, 330, 390, 560, 820, 1,000, 1,200, 1,800, 2,200, 2,700, 3,300, 3,900, 5,600, 6,800, 8,200, 0·01, 0·012, 0·015, **2/6** doz. Post/Packing, 1/-.

BRAND NEW BOXED CHASSIS containing 2—OC35, 2—OC29 12 WW resistors **25/-**. Postage 1/6

NEW CROSS RADIO
6 OLDHAM ROAD, MANCHESTER 4

BRAND NEW ELECTROLYTICS, 15/16V, 0·5, 1, 2, 5, 6, 8, 10, 15, 20, 30, 40, 50, 100, 200mF, **8d.** Mullard 25V, 6·4, 12·5, 25, 50, 80mF, **10d.** Carbon Film resistors ¼W 5% E12 Series 10 ohms to 1 Megohm **1/6** dozen. Minimum order **7/6**. Postage **1/-**. The C.R. SUPPLY CO., 127 Chesterfield Road, Sheffield, S8 0RN.

Stella Nine Range Cases

Manufactured in Black, Grey, Lagoon or Blue Stelvetite and finished in Plastic-coated Steel, Morocco Finish with Aluminium end plates. Rubber feet are attached and there is a removable back plate. There is also a removable front panel in 18 s.w.g. Alloy.

Now all Aluminium surfaces are coated with a strippable plastic for protection during manufacture and transit. All edges are polished.

LIST OF PRICES AND SIZES
which are made to fit Standard Alloy Chassis

Width	*Depth*	*4" Height* £ s. d.	*6" Height* £ s. d.	*7½" Height* £ s. d.
6½"	3½"	12 6	15 0	18 0
6½"	4½"	13 6	18 0	1 0 0
8½"	3½"	15 0	1 0 0	1 1 0
8½"	6½"	1 1 0	1 6 6	1 11 3
10½"	7½"	1 8 6	1 15 6	1 18 9
12½"	3½"	1 1 0	1 6 6	1 11 0
12½"	5½"	1 8 0	1 14 0	1 17 6
12½"	8½"	1 16 0	2 3 0	2 7 3
14½"	3½"	1 5 0	1 11 6	1 14 0
14½"	9½"	2 3 0	2 15 9	2 18 6
16½"	6½"	1 18 6	2 6 3	2 11 6
16½"	10½"	2 10 0	3 5 0	3 11 9

Cases—Post 4s. 6d. per order.
Discounts available on quantities.

CHASSIS in Aluminium, Standard Sizes, with Gusset Plates
Sizes to fit Cases. All 2½" Walls

	s. d.		s. d.		s. d.
6" × 3"	5 6	10" × 7"	8 6	14" × 3"	7 3
6" × 4"	5 9	12" × 3"	6 9	14" × 9"	14 6
8" × 3"	6 6	12" × 5"	7 6	16" × 6"	10 9
8" × 6"	7 9	12" × 8"	10 9	16" × 10"	16 0

Chassis—Post 3s. 0d. per order.
Discounts available on quantities.

E. R. NICHOLLS
Manufacturer of Electronic Instrument Cases
46 LOWFIELD ROAD
STOCKPORT • CHESHIRE
Tel. 061-480 2179

NEW DEVICES AT LOWEST PRICES. GEPA230 Audio Preamplifier **18/6** each, GEPA234 1W Audio Amplifier **17/6** each, GEPA237 2W Audio Amplifier **32/6** each, GE2N5172 NPN 200mW Transistor **1/9** each. All with data. C.W.O. P. & P. **1/-** per order JEF ELECTRONICS, York House, 12 York Drive, Grappenhall, Warrington, Lancs Mail Order Only.

P.C. BOARDS brand new but have corners cut off at the request of the manufacturer.
P.C.1: Rectifier assembly with 4 silicon diodes HS3108 800 P.I.V. at 165mA, 1 25μF 50v.w. transistor electrolytic, 1 germanium diode 2102, 2 resistors, 1 R.F. choke, **4/6** each.
P.C.2: Rectifier assembly with 4 silicon diodes HS3106 600 P I.V. at 165mA, 4 silicon diodes 1S134 400 P.I.V. at 200mA, 1 germanium diode 2102, 6 resistors, 1 capacitor 25μF 50v.w. **6/6** each.
P.C.3: 2nd mixer units OA73 as mixer, AF114 crystal oscillator with 11·155MHz, miniature wire ended crystal, GET887 or equivalent as 455 I.F. amp converts 10·7MHz I.F. to 455kHz with connecting data, used ex-equip. **12/6.**
P.C.4: Board containing 2 NKT223A, 1 NKT228, 9 transistor electrolytics, 4 paper capacitors, 18 1/10th watt resistors, 1 pot core, B7G valveholder and miniature potentiometer, **6/6** each.
New supply of receiver panels as previously advertised at **32/6** post paid. Send for list of other P.C. boards, I.F. strips, R.F. units, modulators, etc.
TUNING CAPACITORS 125 + 125pF, approx. 1in. cube, ¼in. spindle direct drive, only **3/6** (brand new).
TAG STRIPS. 4½in. long, 9 insulated tags and 2 earth tags box of approx. 144 new and unused to clear at **15/-** post paid.
ELECTROLYTICS (can type) 32μF 450v.w. **4/6** each.
POLYSTYRENE capacitors 1,000pF and 5,000pF 30v.w. 5 per cent tol. **2/6** doz.
OUTPUT transformers to suit single ECL86, etc., **4/-** each.
TRANSISTOR 470kHz. single tuned I.F. transformers, no data, 1/- each
S.A.E. for new list. Postage and Packing plus 1/6. Mail Order Only.

A. J. H. ELECTRONICS
59 WAVERLEY ROAD, THE KENT
RUGBY, WARWICKSHIRE. RUGBY 71066

DIOTRAN SALES

P.O. BOX 5
WARE, HERTS
TEL.: WARE 3442

SIL. G.P. DIODES

300mW	30	10/–
40PIV (Min.)	100	30/–
Sub-Min.	500	£5
Fully Tested	1,000	£9

Ideal for Organ Builders.

Post and Packing costs are continually rising. Please add 1/- towards same. **CASH WITH ORDER PLEASE. GIRO No. 30-102**

OVERSEAS QUOTATIONS BY RETURN SHIPMENTS TO ANYWHERE IN THE WORLD

OVER 3 MILLION SILICON ALLOY & GERM. TRANSISTORS AVAILABLE FOR IMMEDIATE DELIVERY

TRANSISTORS Type and Construction		Qty. Price 100	Qty. Price 500	Qty. Price 1,000	Qty. Price 10,000
A 1	Germ. A.F. NPN T0-1	=AC127, NKT773, AC157, ASY86	£3.10	£15	£25	£200
A 2	Germ. A.F. PNP T0-5	=ACY17-21, NKT237-245	£1	£3	£5	£40
A 3	Germ. A.F. PNP T0-1	=AC128, NKT271, 2G381	£1	£3	£5	£40
A 4	Germ. R.F. PNP T0-1	=OC44-45, NKT72/125, ASY54	£1.10	£4.10	£7.10	£60
A 5	Germ. R.F. PNP T0-5	=2N1303, NKT164-7, 2G301-3	£1.10	£4.10	£7.10	£60
A 6	Germ. V.H.F. PNP T0-1	=AF116-7, KNT667, 2G417	£3.10	£15	£25	£200
A 7	Assorted Germ. A.F.-R.F. PNP mixed cans, general purpose		15s.	£2.10	£4	£32
A 8	Germ. A.F. S0-2 PNP	=2G371-89, ACY27-31, OC71-75	£2	£7.10	£12.10	£100
A 9	Sil. Alloy PNP T0-5	=2S301-5, BCY17-29, BCY30-34	£2	£7.10	£12.10	£100
A10	Sil. Alloy PNP S0-2	=2S321-325, OC200-205	£2	£7.10	£12.10	£100

A1 to A7 Guaranteed 80% Good usable Transistors ideal for low cost production work and experimental use. A8 to A10 are all perfect devices, factory tested, no open or short circuit Transistors in these lots.

BRAND NEW FULLY TESTED EPOXY CASE UNIJUNCTION TRANSISTORS. Type TIS43 and BEN 3000 and replacement for 2N2646. Full data available. LOWEST PRICE AVAILABLE ANYWHERE. 100 off 4/- each = £20; 500 off 3/6 each = £87.10; 1,000 off 3/- each = £150. Sample devices 7/- each on request.

HIGH QUALITY SILICON PLANAR DIODES. SUB-MINIATURE DO-7 Glass Type, suitable replacements for OA200, OA202, BAY38, IS130, IS940. 200,000 to clear at £4 per 1,000 pieces. GUARANTEED 80% GOOD.

SILICON PLANAR PLASTIC TRANSISTORS. 2N3708A VcB30 Hfe 20-60. All marked fully tested and guaranteed. 1 off 1/6 each; 100 off 10d. each; 500 off 9d. each; 1,000 off 7½d. each.

TO-5 METAL CAN SILICON PLANAR TRANSISTORS. VERY HIGH QUALITY 99% good type. 2N697, BFY51, 2N1893, £8 per 500 pieces. £13/0/0 for 1,000 pieces.

FULLY TESTED DEVICES AND QUALITY GUARANTEED—SURPLUS TO REQUIREMENTS

OA202 Silicon Diode. Fully Coded.
150 PIV 250mA Qty. Price £30 per 1,000 pieces.

02A00 Silicon Diode. Fully Coded.
50PIV 250mA. Qty. Price £25 per 1,000.

BY100 SIL. RECT'S 800 PIV 550mA.
1-49 2/6 each; 50-99 2/3 each; 100-999 2/- each; 1,000 up 1/10 each. Fully Coded. 1st Qlty.

PLASTIC PNP SILICON TRANSISTORS. Manufacturers' seconds from 2N3702–3 family. Ideal cheap trans. for manufacturing, etc. £8.0.0.—500, £13.10.0—1,000 pieces.

PLASTIC NPN SILICON TRANSISTORS. Manufacturers' seconds from 2N3707–3711 family. Ideal cheap trans. for manufacturing, etc. £7.10.0—500, £12.0.0—1,000 pieces.

TO-18 METAL CAN SILICON PLANAR TRANS. Very high quality, 99% good. Type 2N706, BSY27, £8 per 500 pieces. £13 per 1,000 pieces.

TOP HAT RECTIFIERS. All good. No short or open circuit devices. Voltage range 25–400PIV, 750mA. £3 per 100, £12.10.0 per 500.

S.C.R.'s 16AMP (unplated)

1–24	25–99	100 up
100PIV, 9/6	7/6	6/–
400PIV, 14/–	12/–	10/–

All tested perfect functional devices guaranteed.

1/- each TESTED TRANSISTORS 1/- each

ONE PRICE ONLY PNP. NPN. SILICON PLANAR 1/- EACH

BC108	2N696	2N1132	2N2220	2S733
BC109	2N697	2N1613	2N3707	2N3391
BFY50	2N706	2N1711	2N3711	TIS44
BFY51	2N708	2N2904	2S102	2N2906
BFX84	2N929	2N2905	2S103	2N2907
BFX86	2N930	2N2924	2S104	2N2696
BFX88	2N1131	2N2926	2S732	2N3702
				2N3703

From Manufacturers' Over-runs—Unmarked Plastic and Metal cases. Devices similar to above Nos.

GERM. PNP AND NPN TRANSISTORS FULLY TESTED, UNMARKED SIMILAR TO 1/6 EACH

AC125	ACY22	ACY36	NKT677	OC81	2G381
AC126	ACY27	NKT141	NKT713	OC82	2G382
AC127	ACY28	NKT142	NKT773	2G301	2G399A
AC128	ACY29	NKT212	OC44	2G302	
AC130	ACY30	NKT213	OC45	2G303	
ACY19	ACY31	NKT214	OC71	2G308	1/6 each
ACY20	ACY34	NKT215	OC72	2G371	
ACY21	ACY35	NKT271	OC75	2G374	

POWER TRANSISTORS

OC25	OC35	NKT403	ASZ17	5/- each
OC26	AD130	NKT404	T13027	
OC28	AD140	NKT405	T13028	
OC29	AD149	NKT452	T13029	

Manufacturers' Surplus Germ. A.F. All similar to above.

TRANSISTOR EQVT. BOOK

2,500 cross references of transistors—British, European, American and Japanese. A must for every transistor user. Distributed by DIOTRAN SALES. 15/- EACH.

TEXAS 2G371 A/B Eqvt. OC71 Germ. Gen. Purpose Trans.

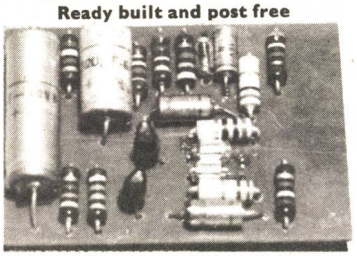
	Each
1-99	1/6
100-499	1/3
500-999	1/-
1000 up	9d.

All Brand New and Coded.

Vast mixed lot of subminiature glass diodes. Comprising of Silicon, Germ., Point Contact and Gold Bonded types plus some Zeners. 500,000 available at Lowest of Low Price. 1,000 pieces £3.0.0. 5,000 pieces £13.10.0. 10,000 pieces £23.

HIGH QUALITY PLUG-IN MODULES

Using the latest silicon-planar devices
Ready built and post free



M1.	Microphone 30/60 Ω 50dB. gain	50/–
M2.	Microphone 600 Ω 50dB. gain	50/–
M3.	Microphone 50K Ω 50dB. gain	50/–
	All above modules have a signal to noise ratio of –64dB. and by switching a single resistor can be set to give 40, 50, or 60dB. gain.	
M4.	Magnetic Pickup 1·5mV/cm/sec. RIAA.	50/–
M5.	Magnetic Pickup 4mV/cm/sec. RIAA.	50/–
M6.	Ceramic Pickup 100mV RIAA.	50/–
M7.	Tuner/Tape-Amp. 100mV. Input impedance 1M Ω using F.E.T. input stage	60/–
M8.	Hi-Level Pre-Amp IV. Input impedance 1M Ω	50/–
M9.	Mixer, for mixing up to 10 channels into M10. M1. to M9. all have 10K Ω output impedance	50/–
M10.	Line Amplifier, delivers up to 20dBM.	50/–
M11.	Tape Replay. Switched equalisation for 1⅞, 3¾, 7½ & 15ips. D.I.N. Type A for 100mH. heads. Type B for 500mH. Heads. (State type required when ordering)	60/–
M12.	Power Supply for above modules.	100/–

If required all modules except M12. can be supplied on professional quality fibreglass material at an additional cost of 5/– per module. If this is required prefix module F/X when ordering, e.g. F/X M11 B. Full connection details with each module.

Printed Circuit Edge Connectors for above modules 5/–.

S.A.E. with all enquiries please. Mail order only.

DABAR ELECTRONIC PRODUCTS (Dept. 4)
98a, Lichfield Street
Walsall, Staffs.

BAKER MAJOR £8

The remarkable quality and performance of the **"Major"** makes possible truly brilliant and rich sound from a single loudspeaker. It recreates the entire musical spectrum from 30 to 14,500 c.p.s. The unit consists of the latest double cone, woofer and tweeter cone together with a special **Baker** magnet assembly **Alcomax II** having a flux density of 14,000 gauss and a total flux of 145,000 Maxwells. Bass resonance 45 c.p.s. Rated 20 watts. Voice coils available 3 or 8 or 15 ohms. **Price £8,** or Module as illustrated 30-17,000 c.p.s. with tweeter, crossover, baffle and instructions. **£10.19.6.**

Baker Reproducers Ltd

Bensham Manor Road Passage, Thornton Heath, Surrey. 01-684 1665

DO GARAGE BILLS MAKE SENSE?

Get down to tackling those maintenance and repair jobs yourself. PRACTICAL MOTORIST shows you how do-it-yourself car care is the big economy in the long run. Follow its expert guidance every month and you can get sweeter running, safer driving, worry-free performance all round—*and* save yourself some garage bills! Start the 'seventies right by placing a regular order.

PRACTICAL motorist

THE WIDEST READ MOTORING MONTHLY THAT CUTS COSTS
JANUARY ISSUE OUT NOW 2/6

VALUABLE NEW HANDBOOK

FREE TO AMBITIOUS ENGINEERS

Have you had *your* copy of "Engineering Opportunities"?

The new edition of **"ENGINEERING OPPORTUNITIES"** is now available—without charge—to all who are anxious for a worthwhile post in Engineering. Frank, informative and completely up to date, the new **"ENGINEERING OPPORTUNITIES"** should be in the hands of every person engaged in any branch of the Engineering industry, irrespective of age, experience or training.

On 'SATISFACTION OR REFUND OF FEE' terms

This remarkable book gives details of examinations and courses in every branch of Engineering, Building, etc., outlines the openings available and describes our Special Appointments Department.

WHICH OF THESE IS YOUR PET SUBJECT?

ELECTRONIC ENG.
Advanced Electronic Eng.— Gen. Electronic Eng.— Applied Electronics — Practical Electronics — Radar Tech.— Frequency Modulation — Transistors.

ELECTRICAL ENG.
Advanced Electrical Eng.— General Electrical Eng. — Installations — Draughtsmanship — Illuminating Eng. — Refrigeration — Elem. Elec. Science — Elec. Supply — Mining Elec. Eng.

CIVIL ENG.
Advanced Civil Eng.— General Civil Eng. — Municipal Eng. — Structural Eng. —Sanitary Eng.—Road Eng. — Hydraulics — Mining — Water Supply — Petrol Tech.

RADIO & T.V. ENG.
Advanced Radio — General Radio—Radio & TV Servicing — TV Engineering — Telecommunications — Sound Recording — Automation — Practical Radio — Radio Amateurs' Examination.

MECHANICAL ENG.
Advanced Mechanical Eng.— Gen. Mech. Eng.—Maintenance Eng. — Diesel Eng. — Press Tool Design — Sheet Metal Work — Welding — Eng. Pattern Making — Inspection - Draughtsmanship — Metallurgy — Production Eng.

AUTOMOBILE ENG.
Advanced Automobile Eng.— General Auto. Eng. — Auto. Maintenance — Repair — Auto. Diesel Maintenance — Auto. Electrical Equipment— Garage Management.

WE HAVE A WIDE RANGE OF COURSES IN OTHER SUBJECTS INCLUDING CHEMICAL ENG., AERO ENG., MANAGEMENT, INSTRUMENT TECHNOLOGY, WORKS STUDY, MATHEMATICS, ETC.

Which qualification would increase your earning power? A.M.I.E.R.E., B.Sc.(Eng.), A.M.S.E., A.M.I.P.E., A.M.I.M.I., A.R.I.B.A., A.I.O.B., A.M.I.Ex., A.R.I.C.S., M.R.S.H., A.M.I.E.D., A.M.I.Mun.E., C.ENG., CITY & GUILDS, GEN. CERT. OF EDUCATION, ETC.

BRITISH INSTITUTE OF ENGINEERING TECHNOLOGY
316A ALDERMASTON COURT, ALDERMASTON, BERKSHIRE

THIS BOOK TELLS YOU

- ★ ***HOW to get a better paid, more interesting job.***
- ★ ***HOW to qualify for rapid promotion.***
- ★ ***HOW to put some letters after your name and become a key man . . . quickly and easily.***
- ★ ***HOW to benefit from our free Advisory and Appointments Depts.***
- ★ ***HOW you can take advantage of the chances you are now missing.***
- ★ ***HOW, irrespective of your age, education or experience, YOU can succeed in any branch of Engineering.***

164 PAGES OF EXPERT CAREER - GUIDANCE

PRACTICAL EQUIPMENT

Basic Practical and Theoretic Courses for beginners in Electronics, Radio, T.V., Etc., A.M.I.E.R.E. City & Guilds Radio Amateurs' Exam. R.T.E.B. Certificate P.M.G. Certificate Practical Electronics Electronics Engineering Practical Radio Radio & Television Servicing Automation

INCLUDING TOOLS

The specialist Electronics Division of B.I.E.T. NOW offers you a real laboratory training at home with practical equipment. Ask for details.

B.I.E.T.

You are bound to benefit from reading **"ENGINEERING OPPORTUNITIES"** — send for your copy *now*— FREE and without obligation.

POST COUPON NOW!

TO B.I.E.T., 316A ALDERMASTON COURT, ALDERMASTON, BERKSHIRE.

Please send me a FREE copy of "ENGINEERING OPPORTUNITIES." I am interested in (state subject, exam., or career).

.....

NAME .....

ADDRESS .....

.....

.....

WRITE IF YOU PREFER NOT TO CUT THIS PAGE

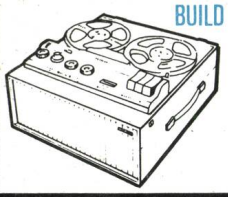
THE B.I.E.T. IS THE LEADING INSTITUTE OF ITS KIND IN THE WORLD

Published approximately on the 15th of each month by IPC Magazines Limited, Tower House, Southampton Street, London, W.C.2. Printed in England by The Chapel River Press, Andover, Hants. Sole Agents for Australia and New Zealand—Gordon & Gotch (A/sia) Ltd. : South Africa—Central News Agency Ltd. : Rhodesia, Malawi and Zambia—Kingstons Ltd. East Africa—Stationery and Office Supplies Ltd. Subscription Rate (including postage) : For one year to any part of the world £2 2s. 0d.

Practical Electronics is sold subject to the following conditions, namely, that it shall not, without the written consent of the Publishers first given, be lent, resold, hired out or otherwise disposed of by way of Trade at more than the recommended selling price shown on the cover, and that it shall not be lent, resold or hired out or otherwise disposed of in a mutilated condition or in any unauthorised cover by way of Trade, or affixed to or as part of any publication or advertising, literary or pictorial matter whatsoever.

HENRY'S RADIO LTD. ENGLAND'S LEADING COMPONENT AND EQUIPMENT CENTRES

BUILD A QUALITY 4 TRACK TAPE RECORDER



To get the best out of your MAGNAVOX DECK, you need a MARTIN RECORDAKIT. This comprises a special high quality 6 valve amplifier and pre-amplifier which comes to you assembled on it's printed circuit board — in fact everything for making a superb Tape Recorder. You need no experience or technical skill to bring this about.
THE INSTRUCTIONS MANUAL MAKES BUILDING EASY, AND SUCCESS IS ASSURED.
Kit comprises: Deck, Amplifier, Cabinet and speaker, with microphone, 7" 1200 ft. tape, and spare spool.
ASK FOR BROCHURE 6. TODAYS VALUE £60.
PRICE 39 gns. p.p. 22/6. NOTHING ELSE TO BUY

HENRY'S RADIO *Fully Illustrated* CATALOGUES

A
ALL TYPES OF ELECTRONIC COMPONENTS TEST EQUIPMENT KITS BUILT UNITS

B
HIGH FIDELITY & GENERAL AUDIO EQUIPMENT CATALOGUE

COMPREHENSIVE · CLEAR · CONCISE · CATALOGUES

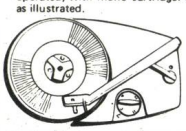
A Over 300 pages fully detailed and illustrated with more than 6,000 stock items. Everything for amateur and professional use. Complete with 5 vouchers. 10/- value, for use with purchases.
ORDER AS CATALOGUE A **PRICE 7/6. p.p. 2/-.**

B New audio and high fidelity catalogue. 120 pages containing ideas and equipment for every application. Special low prices for all leading makes Plus 12/6 extra discount voucher.
ORDER AS CATALOGUE B **PRICE 5/-. p.p. 1/-.**

WHY NOT SEND AWAY TODAY!

SCOOP! STAAR RECORD PLAYER

Deck plays 33, 45, 78, R.P.M. records. 9 volt operated, with mono cartridge. BRAND NEW . . . as illustrated.



PRICE 59/6. p.p. 3/6.
Send for leaflet No. 2.

MULLARD 1 WATT AMPLIFIER

Portable Transistor Unit-Ideal for Intercoms, Baby Alarms, Tele phone, Record Players or Guitar Practice.
9 Volt 5 transistors with volume control, output 3 ohms.
Ideal for use with STAAR RECORD DECK.
PRICE 45/-. p.p. 2/6.
OTHER ITEMS. Suitable 7 x 4 inch. 3 ohm speaker 17/6 p.p. 1/6.
Rexine covered cabinet 12 x 9 x 4 12/6 p.p. 2/6.
P.P.9 9 volt battery 3/9. Write for leaflet No. 2.

GARRARD RECORD DECKS

All the latest models BRAND NEW and guaranteed – TERRIFIC SAVINGS !

*2025 STEREO	£ 7.19.6.
*2025TC DIAMOND. 9TAH.C.	£ 9.19.6.
*3000 STEREO 9TAH.C.	£ 9.19.6.
*SP 25 Mk.II	£11.19.6.
*SL 55	£11.19.6.
A70 Mk.II.	£12.10.0.
*AT 60 K.II.	£13.10.0.
*SL 65	£14.14.0.
AP 75	£19. 0.0.
401	£28. 7.6.
SL 75	£29. 0.0.
SL 95	£35. 0.0.
GL 75 GOLDRING	£33. 0.0.
GL 75 P "	£46.15.0.

ALSO IN STOCK — THORENS — LENCO — B.S.R
Carriage/insurance 7/6 extra on any model.
WB4 BASES £3.19.6. PERSPEX COVERS £3.10.0.
*Special offer base and cover available for these models at £4.15.0. Carriage 5/-.
Complete range of Cartridges/Plinths/Covers.
SEND FOR 8 PAGE BROCHURE 16/17 TODAY.

BUILD YOURSELF A QUALITY RADIO

New printed circuit design with full power output. Fully tuneable on both mw/lw. bands. 7 Mullard transistors, Fitted 5" speaker, Room Filling Power. Easy to build with terrific results. All local and continental stations. Complete detailed instructions.
TOTAL COST £6.19.6. p.p. 4/6.
Ask for Leaflet No. 1.

TRANSISTORS DIODES RECTIFIERS

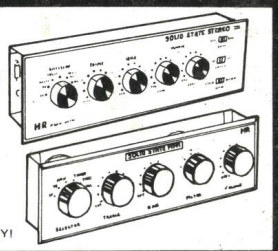
WE HAVE THE MOST COMPREHENSIVE STOCK IN GREAT BRITAIN.
NEW 1969 LIST OF 1000 TYPES.
SEND FOR **FREE** COPY TODAY (LIST 36)
Whether you require one or 1000, devices we can fulfil your order from stock!.
For quantity quotations telephone: (01) 723 0401 Ex. 4. or (01) 402 6823.

AUDIO EQUIPMENT

Mono or Stereo Audio equipment developed from Dinsdale Mk.II — each unit or system will compare favourably with other professional equipment selling at much higher prices.
COMPLETE SYSTEMS AND MIXERS from
£11.12.6. to **£38.17.6.** (all units available separately).

THE FINEST VALUE IN LOW COST HIGH FIDELITY — CHOOSE A SYSTEM TO SUIT YOUR NEEDS AND SAVE YOURSELF POUNDS.

SEND FOR BROCHURES No. 12/14 and 21 TODAY!



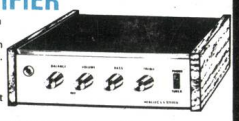
HI-FI equipment to suit EVERY POCKET

HIGH FIDELITY AUDIO EQUIPMENT CATALOGUE 5/- p.p. 1/-

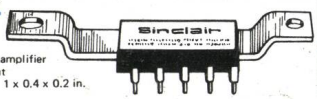
VISIT OUR NEW HI-FI CENTRE AT 309 EDGWARE ROAD, for all leading makes of — AMPLIFIERS, TUNERS, DECKS, SPEAKERS, MICROPHONES, TEST EQUIPMENT. ALL WITH DISCOUNTS — IT WILL PAY YOU TO PAY US A VISIT. AUDIO SYSTEMS £40 — £300 TO SUIT EVERY POCKET. DEFERRED TERMS AVAILABLE.
SEND FOR ILLUSTRATED BROCHURE 16/17. **TWO DEMONSTRATION ROOMS**

HENELEC 5–5 STEREO AMPLIFIER

Excellent low priced British designed Stereo Amplifier for use with Record Decks, Mike, Tuners.
16 transistor mains operated. Output 5+5 watts for 8- 15 ohm speakers. Black, silver and wood finish, size 13" x 3" x 6".
PRICE £13.10.0. p.p. 7/6. (Leaflet on request).
Complete Stereo System 5-5.
Garrard 2025 stereo, 5-5 Amplifier, Plinth/Cover, Two 10 watt speakers with tweeters in polished cabinets.
Usual price £47.0.0. OUR PRICE £39.10.0. p.p. 20/-. ASK FOR BROCHURE.13



SINCLAIR EQUIPMENT



The SINCLAIR IC-10 is the worlds first monolithic intergrated circuit high fidelity power amplifier and pre-amplifier. The circuit itself has an output power of 10 watts, yet with an overall size of 1 x 0.4 x 0.2 in.

IC-10 Integrated Circuit Amplifier	59/6
Z30	89/6
Stereo 60	£9.19.6.
PZ5 Power Supply	£4.19.6.
Q16 Loud Speaker	£8.19.6.
Z12 Amplifier	89/6
PZ 4 Power unit	99/6
Stereo 25	£9.19.6.
Q14 Speaker system	£7.19.6.
All post paid, delivery from stock.	

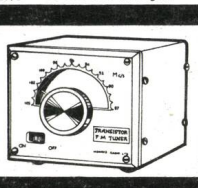
OTHER TYPES OF INTEGRATED CIRCUITS

RCA. CA3014	29/6	G.E. PA246*	52/6
RCA. CA3018	22/6	SL402 Plessey	45/0
RCA. CA3020	29/6	SL403 Plessey	49/6
RCA. CA3036	18/6	S.G.S. UL910	10/0
Sinclair I.C.10.	59/6	S.G.S. UL900	10/0
G.E. PA230*	22/6	S.G.S. UL914	11/0
G.E. PA234*	20/0	Mullard TAA263	15/0
G.E. PA237*	37/6	*Data sheets 3/6 set for these, for others see catalogue.	

BUILD THIS VHF FM TUNER

5 MULLARD TRANSISTORS. 300 kc/s BANDWIDTH. PRINTED CIRCUIT. HIGH FIDELITY REPRODUCTION MONO & STEREO. A popular VHF FM Tuner for quality and reception of mono and stereo. There is no doubt about it — VHF FM gives the REAL sound.

PARTS TOTAL COST £6.19.6. DECODER £5.19.6.
ASK FOR LEAFLET No. 3. **(FOR STEREO)**



Electronic Musical Instruments

ELECTRONIC ORGANS

COMPLETE KITS FOR THE HOME CONSTRUCTOR

START BUILDING FOR AS LITTLE AS £10.
MODELS FROM £99 – £350.

STAR FEATURES:
*ALL TRANSISTOR PRINTED CIRCUIT DESIGNS. *BRITISH DESIGN. *STEP BY STEP DETAILED INSTRUCTIONS. *SAVES UP TO 50% ON COMMERCIAL EQUIVALENT. *EVERYTHING SUPPLIED DOWN TO THE LAST ITEM. *FULL AFTER-SALES SERVICE & ADVICE. *CREDIT SALE & H.P. TERMS AVAILABLE.

We are pleased to offer the choice of FOUR British designs from a single manual portable at £99 THE MAYFAIR for light or classical music — to a two manual five octave de-luxe model with OAK CONSOLE from £285 for the serious musician.

These kits are the result of years of research and design and offer the best that is essential to good organ designs, coupled with excellent value are within the reach of most pockets. No technical skill or knowledge is required in construction, with the aid of the STEP BY STEP illustrated manuals will produce an instrument that will be a delight to own and use and will give years of trouble free entertainment for the whole family.

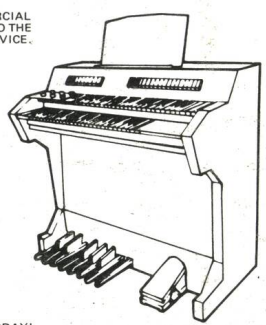


ILLUSTRATION of GROSVENOR ELECTRONIC ORGAN

SEND FOR ILLUSTRATED BROCHURES 9/10/11 TODAY!
When in LONDON. . . CALL IN SEE, HEAR, PLAY FOR YOURSELF.
Organ Demonstration Room 1st Floor.
PRACTICAL ELECTRONICS ORGAN — ORGAN COMPONENTS

We are able to supply all items for this series, details on request. **Built models available from £124.**

HENRY'S RADIO LTD.

Mail Order Dept., Components, Organ Dept.
303 EDGWARE ROAD, LONDON W.2.
Telephone: 01-723 1008/9

High Fidelity and Equipment Centre
309 EDGWARE ROAD, LONDON W.2.
Telephone: 01-723 6963

OPEN MON-SAT 9am-6pm THURS 9am-1pm